# SERVICE MANUAL

# INTERNATIONAL TRACTORS LIMITED HOSHIARPUR

### FOREWORD

The service manual is prepared as reference material for the service personnel of authorized ITL dealers to enable them to correctly carry-out the task of rendering services and maintenance on ITL Tractors.

In order to ensure that the customers are satisfied with ITL products, proper servicing and maintenance must be provided. For this purpose, the service personnel must fully understand the contents of this manual and at the same time, are recommended to keep the manual in a place where reference can readily be made.

The information, photographs, drawings and specifications entered in this manual are the best available at the time of printing this manual. Any alteration to this manual occurring as the result of modifications will be notified by the issuance of Service Informations or supplementary volumes. It is therefore, requested that the manual must be kept up-to-date by carefully maintaining a follow-up of these materials.

ITL reserves the right to alter the specifications and contents of this manual without any prior notice.

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# **INSTRUCTIONS TO USER**

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SERVICE MANUAL

A

# **INSTRUCTIONS TO USERS**

### A. 1.0 MAINTENANCE

CONSULT THIS MANUAL THOROUGHLY, as proper functioning and good efficiency of mechanical organs depends mostly on constant and correct routine maintenance ensuring product integrity and expected life duration. In case of any damages or anomalies, quick intervention of specialized personnel can avoid future impairment and lengthen the working life.

### REPAIR

The disassembly/assembly procedures have been outlined for a total product overhauling. They have also been described in sequence through photographs with relevant explanation for specific interventions, thus obtaining a complete and safe guide for each and every phase of an operation.

Operation description presumes that the group has already been removed from the vehicle. The manual supplied by the vehicle manufacturer should be consulted in case of overhauling or maintenance intervention requiring the removal of the machine.

### GENERAL

The **TRACTOR** should be checked and/or repaired only by qualified technicians, acquainted with its peculiar features and well aware of all safety instructions. Before performing any operation it is advisable to carry out-group cleaning accurately by removing oil/grease encrustation and accumulation. All disassembled mechanical parts must be cleaned accurately with suitable products to avoid possible damage.

Parts should be replaced if damaged, worn out, cracked, seized, etc. As they could affect proper working. Rotating parts (bearings, gears, shafts) and that of hardware/fasteners (O-Ring, oil seals) should be examined carefully, as they are subject to major stress, wearing and ageing. We advise to replace tightening parts during every repair. Use genuine spare parts, nuts and bolts to avoid any other problems. Moreover, use metric tools for metric nuts and bolts and Imperial tools for the others.

Read & understand these instructions carefully to avoid damage to any person or machine.

### A.2.0 SAFETY RECOMMENDATIONS FOR REPAIR OPERATIONS

Recommendations and all described procedures given in this manual have been experimented and carefully tested. Please follow every procedure.

It is impossible to advise every working method or know all possible methodologies for carrying it out or to predict risky consequences of each operation. Hence, performing procedures or using instruments which have not been advised could be dangerous for the operator/mechanic as well as the vehicle.

### PRECAUTION

Safety goggles must be worn while carrying out any assembly or disassembly operation.

#### **GENERAL PRECAUTIONS**

Observe safety instructions, accident prevention rules and all general safety regulations in each and every step at work. Before going ahead with maintenance or repair work ensure that all the tools, the supporting bench, stands, levers, extractors and spanners are in good condition so that the work can be carried out easily. Risks to various parts and components will also be reduced in this way and working condition for the operator will also be safer.

A-1

### A.3.0 SAFETY MAINTENANCE RULES

1. Operate in a clean and dry environment.

2. Always be prepared for fires. Keep the extinguisher and the first aid kit within reach.

3. Keep the phone numbers of a doctor, an ambulance, a hospital and the fire department with in reach near the telephone set.

4. Wear suitable clothing and protection such as overalls, safety gloves and ear safety devices.

5. Use suitable ear protection, like earplugs, to keep out noise and prevent injury to the ears. A prolonged exposure to noise can damage your hearing.











A-2

#### A.4.0 HOWTO READTHE MANUAL

This book will give you a brief description of servicing of tractor, which is essential to obtain the best performance from your tractor and work in complete safety. No part of this manual may be reproduced, in any from or by any means, without prior written permission of **InternationalTractor Limited**.

**International Tractor Limited (ITL)** reserves the right to alter or modify the specifications and contents of this manual without any prior notice. Only the customer, whom the manual, together with the product, has been issued to, is allowed to use this document, and only in order to use, maintain and repair the product. The manufacturer shall not be held liable for direct or indirect damages to persons, things or animals due to an improper use of this document or of the machine which does not comply with what is mentioned in this manual.

This manual represents different section of tractor like Brake, Clutch, Gearbox, Differential, Hydraulic, Front axle and Steering unit etc. In each section following steps have been covered.

- **INTRODUCTION**: Under this head general contents and role of that particular section in the tractor models is mentioned.
- SPECIFICATIONS : Under this head technical data of that section in terms of the tractor models is discussed.
- DETAIL VIEWS : Under this head the detail view of that section in terms of the tractor models is mentioned.
- **DISMANTLING PROCEDURE** : Under this head the dismantling procedure of that section from the tractor is mentioned.
- **ASSEMBLY PROCEDURE** : Under this head the assembly procedure of that section on the tractor is mentioned.
- **INSPECTION PROCEDURE** : Under this head the contents to be verified of that section to obtain the best performance from the tractor is discussed.
- TROUBLE SHOOTING : Under this head different problems of that section along with causes and solutions are discussed.

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MAINTENANCE INTERVAL (HRS)	EVERY 10	50	250	500	750	1000	1250	1500
SERVICE ITEM								
GENERAL								
COMPLETE WASHING		- APR	10	100	1	18	1	
NIPPLE GREASING		ſ	Ţ	Ť	Ţ	Ţ	Ţ	T
COOLANT LEVEL	√×	ô	1 %	1 %	1 %	√×	ô	√×
AIR CLEANER								
AIR CLEANER ELEMENT (DRY)		٦¢ ۲	÷٢	÷٢	0	<del>گ</del> ر ۲		0
AIR INTAKE HOSE CLAMPS	×	×	×	×	×	×	×	×
ENGINE		10						
ENGINE VALVE CLEARANCE		1	1	1	1	1	1	1
ENGINE OIL		0	0	0	0	0	0	0
ENGINE OIL FILTER		0	0	0	0	0	0	0
ENGINE IDLE SPEED		1 %	1 %	1 %	1 %	ô	√×	1 %
FUEL INJECTION TIMING		√ %	√ %	1 %	1 %	√ %	ô	√ %
TURBO CHARGER INTAKE HOSE CLAMPS		×	×	×	×	×	×	×
BELL HOUSING NUT & BOLTS		X	X	X	X	X	X	×
COOLING SYSTEM								
FAN BELT TENSION	1 2	1××	XX	XX	XX	XX	XX	X
COOLANT SYSTEM FLUSHING								0
CLUTCH								
CLUTCH OPERATION & PEDAL FREE PLAY	12	1×	1× X	1× X	1× X	√× X	√× X	1×

### A 5.0 RECOMMENDED SCHEDULE FOR MAINTENANCE SERVICE

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MAINTENANCE INTERVAL (HRS)	EVERY 10	50	250	500	750	1000	1250	1500
SERVICE ITEM								
TRANSMISSION/ HYDRAULIC								
OPERATION OF GEARS		1 %	√ ¥	√ %	√ ¥	√ %	√ ¥	1 %
TRANSMISSION / HYDRAULIC OIL		1 %	1 %	1 %	1 %	1 %	1 %	1 %
TRANSMISSION / HYDRAULIC OILFILTER		0	0	0	0	0	0	0
HYDRAULIC OIL STRAINER		$\hat{\mathbf{T}}$	Ĵ	0	۳ <b>۲</b> ۵	<sup>م</sup> ر ک	0	$\hat{\mathbf{x}}$
TRANSMISSION BREATHER	<sup>ش</sup> گ	ᡥᡭ	<sup>م</sup> ر ا	<sup>م</sup> ړ ا	۳ <b>۲</b> ۵	<sup>م</sup> ړ ا	<sup>م</sup> ړ ا	Ť
OPERATION OF LIFT		1 %	1 %	1 %	1 %	1 %	1 %	1 %
FUEL SYSTEM								
PRIMARY FUEL FILTER			0		0		0	
SECONDARY FUEL FILTER				0		0		0
FUEL SEDIMANTOR	D	D	D	D	D	D	D	D
INJECTOR PRESSURE & SPRAY					√ ⊻			
BRAKES								
BRAKE OPERATION & PEDAL								
FREE PLAY	√×	ô	ô	ô	√ ⊻	ô	√ ⊻	ô
BRAKE HOUSING/ LINING							<sup>م</sup> ُرُ	$\hat{\mathbf{x}}$
STEERING								
STEERING OPERATION		√×	1×	√×	1 %	√×	1 %	1×
STEERING TANK OIL FILTER		ô	1 %	ô	1 %	ô	1 %	V×
STEERING OIL FILTER		0						
LINKAGES FOR PLAY		1 %	1 %	1 %	1 %	1 %	1 %	1 %
KING PIN		ô	1 %	√ ¥	1 %	√ %	1 %	1 %
TOE IN		1 %	1 %	1 %	××	1 %	××	××

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MAINTENANCE INTERVAL (HRS)	EVERY 10	50	250	500	750	1000	1250	1500
SERVICE ITEM								
WHEELS & TYRES								
WHEELS NUTS & BOLTS		×	×	×	×	×	×	×
TYRES INFLATION		ô	1 %	ô	1 %	ô	ô	ô
FRONT &REAR AXLE								
STUB AXLE GREASE		ſ	Ţ	T	Ţ	T	T	T
WHEEL BEARING GREASE		Ĩ	Ţ	T	T	T	T	T
BATTERY								
BATTERY ELECTROLYTE LEVEL	1 %	<b>√</b> ⊁	<b>√</b> ≭	√ ≵	<b>√</b> ≵	1 %	1 %	1 %
BATTERY TERMINAL GREASE		Ť	Ť	Ť	Ť	Ť	Ť	Ť
ELECTRICALS								
FUNCTIONING OF OIL GAUGE	1 %	1 %	1 %	1 %	1 %	1 %	1 %	1 %
FUNTIONING OF TEMPERATURE GAUGE	√ ≯	√ ⊻	√ ⊻	√ ⊻	√ ⊻	√ ⊻	√ ⊻	√ ⊻

LEGANDS :-

DRAIN

ADJUST

TIGHTEN

CHECK

REPLACE

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× 1 ¥

A-6



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WASHING



### A 6.0 IDENTIFICATION OF TRACTOR

Fig-1

- 1. In this manual many times written front portion, rear portion, left side, right side understand these terms as per reference Fig-1.
- 2. While ordering spare parts always mention the chassis number and engine number of the tractor. These numbers are punched on the data plate which is riveted on right hand side of front Axle brackd. By giving these numbers correctly, you will get delivery of the right parts at right time. Refer Fig-2. for data plate.



Fig-2



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# ENGINE

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1

### **ENGINE SERVICE DATA**

### FOR ALL ENGINE MODELS

(A)	CYLINDER HEAD AND VALVES	INITIAL (mm)	WEAR LIMIT (mm)
	Max permissible rework on cylinder head mounting face	0.5	-
	Diametrical clearance between valve stem & valve guide	0.03 - 0.065	0.1
	Diametrical clearance between Rocker Arm pin and bush	0.02 - 0.062	0.141
	Valve inner spring free length	55.6 - 56.6	-
	Valve outer spring free length	56 - 57	-
	Tappet Clearance inlet hot and cold	0.2-0.3	
	Tappet Clearance Exhaust hot and cold	0.2-0.4	
(B)	ENGINE BLOCK, LINERS, PISTONS & RODS	INITIAL	WEAR LIMIT
	Max. acceptable block top face out of flat		
	For entire length or width	0.15	
	For every 134 mm length or width	0.03	
	Cam shaft bore	42.0 - 42.025	42.08
	Tappet bores in engine block	27.000 - 27.021	27.075
	Cylinder liner ID (for dia.100)	100.02 - 100.036	100.286
	( for dia.105)	105.049 - 105.069	105.319
	Max. permissible taper	0.02	0.05
	Max. permissible out of round	0.012	0.05
	Bumping clearance between Piston top & Cylinder Head		
	bottom face	0.53 - 0.93	
	Piston ring end gap Ist IInd IIIrd		
	For dia. 100 0.25 - 0.45 0.6 - 0.8 0.3 - 0.55	—	—
	For dia. 105 0.25 - 0.45 0.6 - 0.8 0.3 - 0.55	—	—
	Piston pin to small end bush diametrical clearance	0.009 - 0.03	0.095
	Connecting rod big end bearing to crank pin diametrical	0.04 - 0.098	0.154
	clearance		
(C)	CRANKSHAFT, MAIN BEARINGS		
	Crankshaft pin OD	59.981 - 60.0	—
	Taper ( pin and main journals)	0.015	0.04
	Out of roundness ( pin & main journals )	0.015	0.08
	Undersize Connecting rod bearings available		0.25
	Crankshaft main journal OD	69.981 - 70.0	—
	Undersize main bearings available	0.25	
	Diametrical clearance between Crank & main bearing	0.046 - 0.104	0.16
	I T L B-1	SERVICE M	

(C)	CRANKSHAFT, MAIN BEARINGS	INITIAL	WEAR LIMIT
	End float of Crankshaft in block	0.125 - 0.387	0.6
	Axial play of Connecting rod big end in Crankshaft	0.18 - 0.54	_
	Oversize thrust washers available	0.25	
(D)	CAM SHAFT & TIMING GEARS		
	Diametrical clearance of Camshaft & bores	0.05 - 0.1	0.18
	Camshaft end play	0.1 - 0.4	0.8
	OD of tappets	26.97 - 26.985	26.92
	Diametrical clearance between tappets & bores	0.015 - 0.051	0.155
	TIG Pin OD	87.945 - 87.97	87.905
	TIG bush ID	88.0 - 88.035	88.075
	Diametrical clearance in TIG & bush	0.03 - 0.09	0.175
	Timing gear backlash all gears	0.05 - 0.35	0.9
(E)	LUBRICATION		
	Bore for drive & driven shaft in housing	14.0 - 14.018	14.1
	Diametrical clearance between shaft & bore	0.016 - 0.0695	0.17
	Radial clearance between Gears & housing	0.0375 - 0.0695	0.12
	Axial clearance between Gears & cover	0.022 - 0.091	0.15
(F)	COOLING		
	Radiator cap opening pressure	0.5 - 0.9 bar	
	Thermostat start opening	74° C	
	Thermostat full open	90° C	

### NOTE :- ALL DIMENSIONS IN MM UNLESS OTHERWISE SPECIFIED

### **ENGINE SPECIFICATIONS**

TRACTOR	WORLDTRAC DI-75 2WD / 4WD	WORLDTRAC DI-90 2WD / 4WD
MAKE	SONALIKA	SONALIKA
MODEL	4100FLT	4105FLT
INDUCTION	TURBO CHARGED	TURBO CHARGED
INJECTION	DIRECT	DIRECT
COOLING	WATER COOLED	WATER COOLED
NO. OF CYLINDER	4	4
BORE/STROKE (mm)	100/118	105/118
LINER	WET	WET
COMPRESSION RATIO	18.4:1 ( <u>+</u> 0.2)	18.5:1 ( <u>+</u> 0.2)
INJECTION TIMING (BTDC)	14° <u>+</u> 1°	14° <u>+</u> 1°
IDLE SPEED (RPM)	700 <u>+</u> 50	700 <u>+</u> 50
RATED SPEED (RPM)	2200 <u>+</u> 25	2200 <u>+</u> 25
MAX. SPEED (RPM)	2400 <u>+</u> 50	2400 <u>+</u> 50
HP CATEGORY	75	90
RPM AT MAX. TORQUE	1300 <u>+</u> 100	1400 <u>+</u> 100
FIP MAKE	BOSCH	BOSCH
FIRING ORDER	1-3-4-2	1-3-4-2
INJECTOR MAKE	BOSCH	BOSCH
FUEL TANK (LTRS)	66	66
ENGINE OIL CAPACITY	11.0 LTR	11.0 LTR
TOTAL COOLANT CAPACITY	13	13
AIR CLEANER	DRY TYPE	DRY TYPE
LUB. OIL FILTER	0.50 LTR	0.50 LTR
DIESEL FILTER	0.5 LTR.	0.5 LTR.
(PRIMARY+SECONDARY)		

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### **COMPARISON BETWEEN TREM-III & TERM-III ENGINE**

### **1. Fuel Injection Equipment**

1(a) FIP :-

т	rem-ll		* Tr	em-III	
Element Dia	—	9 mm	Element Dia	—	9 mm
Lift	—	8 mm	Lift	—	9 mm
FIP drive Cone Dia	_	17 mm	FIP drive Cone Dia	_	20 mm

\* In all Trem-III FIPs, positive lubrication is provided. For which FIP is connected to the Engine oil gallery through a pipe. FIP lubrication is done with the engine oil only so there is no need to fill oil in the FIP separately. The excess qty. of oil in the FIP is spilled out through cam shaft (FIP) bearing and then in to the breather area. Whereas in Trem-II FIPs cam shaft end is closed with a seal.



#### 1(b) Injector :-

S-TYPE			P-TYPE		
Туре	—	S type	Туре	—	P type
Holes	—	4 nos.	Holes	—	5 nos.
*Opening Pressure	—	220 (+8) bar	*Opening Pressure	—	250 (+8) bar
(Factory Setting)			(Factory Setting)		
OD (Inj. Holder)	—	21 mm	OD (Inj. Holder)	—	17 mm

\* In all Trem-III (P type) Injectors, 1.5 mm thick washer is used. Whereas in Term-II (S type) Injectors, 2 mm thick washers are being used.

### 1(c) High Pressure Pipe :-

	Trem-II			*Trem-III	
Length		420 mm	Length	_	500 mm
OD		6 mm	OD	—	6 mm
ID	_	1.5 mm	ID	_	1.8 mm

#### 2. Cylinder Head Assy.

For Trem-III engines new design of Cyl. Head has been adopted to accommodate the size and position of P type Injectors.

Valve center distances in Trem-III engines are different from Trem-II engines, whereas inlet & exhaust valves are same for both designs.

#### 3. Piston Assy.

Pistons used for Trem-III engines are modified for better combustion & further to meet the emission requirements for Trem-III.

Pistons for Trem-II & Trem-III are not interchangeable due to different valve centre distances for both designs.

### 4. Injector Clamp, Injector Over flow Pipe, Rocker arm Assy, Valve Cover

In reference with the different Injector mounting position in Trem-III engines, Injector clamp design needed to be changed.

New Injector over flow pipe has been designed inline with the P type injector mounting position.

Inline with the valve center distances of Trem-III engines Rocker arm assy has been modified. This change is only to align the rocker arm center with the valve center.

New sheet metal valve cover for Trem-III engines has been designed to accommodate new valve centre distances & Cyl. Head top face profile.

# GENERAL INSTRUCTION FOR DISMANTLING AND RE-ASSEMBLING

- 1. Dismantling and re-assembling, including repairs, should always be carried out using suitable and high-grade tools or using genuine ITL set of service tools.
- 2. The parts pressed on or heat-assembled should be dismantled only by pressing or using a suitable mandrel. The contact surfaces of parts to be pressed in or shrink on should always be coated with oil properly.
- 3. Re-assembly of dismantled parts should be done with care especially for bearing needles and rollers.
- 4. Properly clean all the parts before assembly and coat their contact surfaces, and especially the friction ones, by oil, grease or sealing compound.
- 5. Paper gaskets, rubber and cork packings and seals, fuses, wires, retaining rings, cotter pins and similar parts should be replaced by new ones.
- 6. Take care to fill up all the repaired groups (components) with oil or grease before putting into service.
- 7. When using a crane, check the crane lifting power and the loading capacity of ropes and suspensions. Use an appropriate lifting gear only.
- 8. Use suitable plugs to blind the open holes of parts or ends of disconnected pipelines. Insulate the disconnected ends of electric wires and mark them unless provided with numbering.
- 9. Depending on the tractor parts (sub-assemblies) to be repaired: drain coolant, or oil, from the engine, or transmission, or the shock absorber, or the hydraulic system, or any other oil, or the hydraulic brake fluid, etc. Check the same has been re-filled again after re-assembly.

### **DISMANTLING THE ENGINE**

The procedure described is based on a condition that the engine has been removed from the final machine . The electric circuit as well as fuel inlet and outlet are disconnected, also Turbo Charger connections & aggregates are removed. As the manufacturer supplies the engine with diversified variants as per customer order (for eg. the cooling systems, wet or dry air cleaner, mounting brackets etc.) only general advices for dismantling the accessories are given. The detailed procedure can differ from case to case.

The dismantling procedures described in the following chapters is to disassemble the engine to the simplest groups or to single parts. If dismantling only some group or component of the engine, observe the respective chapters for the specific operation.

Unless otherwise shown, the steps of assembling separate groups and parts follow in the opposite sequence as described at disassembling, Accordingly, the section referring to assembly point out only the differences or, possibly, give some hints to be observed during the assembly

### **BEFORE DISMANTLING THE ENGINE**

- Drain the coolant from the radiator and the cylinder block into a prepared receiver by means of proper draining system
- Dismount the exhaust manifold
- Dismount the injection pump hand control lever
- Unscrew the drain plug from the oil sump and let the oil off into a prepared receiver
- Remove the alternator and fan guard, release the fixing clips of hoses and elbows of the cooling system, remove the elbow and hoses.
- Unscrew nuts from radiator rubber mounts and remove the radiator
- Unscrew the bolts attaching radiator bracket to the crankcase and remove the bracket; dismantle rear feet of the engine from flywheel housing
- Unscrew the bolts attaching the starter to the crankcase and remove the starter; unscrew the bolt of the alternator struts as well as the bolt attaching the alternator to its holder and remove the alternator
- Unscrew the bolts attaching the fan to water pump pulley and remove the fan, spacer and v-belt; release clips on rubber hoses and elbows of the air cleaner system and remove the hoses and the elbows; remove the air cleaner with its holder;

- Hook the engine by its loops on the hanger; dismantle the flywheel
- Attach the engine to an appropriate revolving assembly stand.

Step 1 Unscrew Drain Plug M20 and drain engine oil.

Step 2 Unscrew three M10 bolts and dismount Starter Motor.

Remove Engine belt and dismount Alternator.

Step 3 Unscrew 4 socket head cap screw M8 & remove Hydraulic Pump.

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Step 4 Unscrew M12 bolts and remove Flywheel.

Step 5 Unscrew M8 bolts and remove the Rear Cover.

Step 6 Remove High pressure pipes.

Step 7 Unscrew M8 nuts of Injector Holder and remove injectors.

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**Step 8** Unscrew Valve cover nuts and remove Valve covers and Gaskets.

**Step 9** Unscrew Rocker arm stud, along with spring washer, B-8 and bolt M8.

Step 10 Remove Rocker Arm assembly.

Step 11 Unscrew Bolt M10 and remove side cover.

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Step 12 Remove all Push rods and Tappets from engine.

**Step 13** Remove the inlet manifold by unscrewing M8 Screws and Washers.

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• Remove Exhaust Manifold by unscrewing M10 Nuts & Washers

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SERVICE MANUAL

Step 14 Remove Inlet and Exhaust manifold gaskets.

Step 15 Remove the Water return Line by unscrewing M8 Screws & Washers.

Step 16 Unscrew the Cyl. Head bolts M16.

Step 17 Remove Cyl. Head from crankcase.

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B-12

**Step18** Dismantling of Cyl. Head sub parts.

(a) Firstly remove Valve cotters and Retainer caps.

(b) Remove Outer and Inner valves spring.

(c) Remove Valve oil seals.

(d) Remove inlet and exhaust valves.









#### B-13

(e) Remove Valve guides of inlet and exhaust valves. (By driving from combustion chamber face)

Step 19 Remove FIP lubrication pipe.

**Step 20** Remove fuel pipes, Fuel filter assy.

**Step 21** Unscrew oil filter cartridge.

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### SERVICE MANUAL

### Step 22

Unscrew Banjo Bolts B13 from crankcase and oil filter body and remove oil filter tube assy

Step 23 Unscrew screw M10 screws and remove Oil filter body.

Step 24 Unscrew M8 & M10 Screws to remove Oil pan bars & oil pan.

Step 25 (A) Unscrew M8 screws to remove Sheet Metal cover.

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(B) Unscrew Suction Strainer nut and remove Suction Strainer.

**Step 26** Unscrew reduction valve assembly and Delivery pipe nut.

Step 27 Unscrew Bolt M10 & remove Oil pump Assy.

**Step 28** Unscrew two M 8 screws & spring washer B-8 to remove Transmission elbow.

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SERVICE MANUAL

Step 29 Unscrew Pulley nut M32x1.5 and washer.

**Step 30** Remove the Crank Pulley with special tool.

Step 31 Unscrew four M10 bolts & remove water pump assy.

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Step 32

Unscrew bolts M10 bolts and 3 socket head screw M10 and 8 nuts M16 to remove the Front Cover.

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SERVICE MANUAL

Step 33 Remove FIP by unscrewing 3 nuts M10, plane & Spring washers B-10.

Step 34 For Direct MTG. FIP's , remove cover from front cover .

Unscrew Special Nut, Reverse it and start tighten to remove FIP.

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SERVICE MANUAL

### Step 35

For Engine With Compressor Housing, unscrew 3 M10 nuts and remove FIP & FIP Coupling Bush.

Step 36

Unscrew the Special bolt M10 and remove the Cam timing gear by puller.







Step 37 Unscrew 3 screws M8 and remove Camshaft retainer.

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B-19

Step 38 Remove the Camshaft with puller.

Step 39

Unscrew Nut M30 And remove HPD gear.

Step 40 Unscrew 3 screws M8 and remove the HPD shaft retainer.

Step 41 Remove HPD shaft assy.

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B-20
Step 42 Unlock the Locking washer and unscrew M30 nut to remove IPD Gear

**Step 43** Remove IPD gear with puller.

Step 44 Unscrew 3 M8 screws & remove IPD shaft retainer.

Step 45 Now pull out IPD shaft from Crankcase.

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SERVICE MANUAL

B-21

Step 46 Remove Lubrication tube assy.

Step 47

Unscrew 3bolts M8 to remove TIG lock plate and pull out the Gear.

**Step 48** Now remove TIG pin from the crankcase.

Step 49 Loose lock Nut M10 and unscrew Lubrication Bolt.

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B-22

Step 50 Unscrew Con .Rod nuts.

Step 51 Now remove the Con Rod cap and slide out piston assy.

Step 52 Remove piston assy and con. rod together by sliding it upwards

Step 53 Remove Circlip to remove piston pin and Con Rod.

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Unscrew Main Bearing Nuts M14 and remove bearing caps.

Step 55 Remove Circlip to remove BIG from front Bearing cap.

**Step 56** Remove rear Bearing cap with Thrust bearings.

**Step 57** Remove Crank shaft from Crankcase.

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B-24

Step 58 Remove Cylinder liners from Crankcase.

**Step 59** Unscrew Oil channel Plug from rear side of Crankcase.

Step 60 Unscrew plug with groove M18 from front side of Crankcase.

Step 61 Unscrew Crankcase Plugs M10.

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B-25

# **ENGINE ASSEMBLY**

B-26

Step 1

Wash the Crankcase and clean properly.

Step 2 Screw 6 crankcase plugs with sealing ring (10/14x1Cu).

Step 3 Fit Union A M10x1 to crankcase in main oil gallery.

**Step 4** Fit three studs M10x30 for FIP mounting in crank case.

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Assembly procedure of Direct Mounting FIP's

Mount FIP slacken M10 nut with plane & spring washer B-10. Imp :- The wood ruff key of FIP should be properly fitted.

Step 6

Align Key way of timing Gear and Fit on FIP. Screw special adopter and tight properly.

#### Step 7

Fit plug with groove M18\*1.5 to plug main oil gallery front side.

#### Step 8

Fit Sealing Rings on Cylinder liner grooves and lubricate. IMP : Ensure twist free setting of Cyl. Sealing Rings.









**Step9** Slide cylinder liners in the Crankcase

**Step10** Press liners into Crankcase using special tool.





# LINER PROJECTION



Clean crankcase upper surface properly after fitting liners. Surface should be leveled and smooth. Place the Dial gauge and set its needle to Zero. Now check liner projection with the help of Dial gauge.

It should be with in 0.060-0.120 mm

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B-28

Step11 Clean the Crank Shaft and its oil holes properly.

**Step 12** Fit key A 10x8x55 on the Crankshaft.

Fit (Radial B/B) 17/40x12ZZ(6203ZZ) on the rear end of crankshaft and put internal circlip B-40.

**Step 14** Heat timing gear (Z22) for crankshaft upto 150°c & fit it on the crankshaft.

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Fit upper half of the main bearing (with groove) to the crankcase properly.

#### Step16

Fit lower half of the main bearing (without groove) to main bearing cap properly.









# Step17

Lubricate main bearings & place crankshaft gently over main bearings.

**Step18** Fit thrust bearings in crankcase and in rear main bearing cap.

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SERVICE MANUAL

B-30

Assembly of Bottom Intermediate gear with front main bearing cap **19(a)** 

Fit Bottom Intermediate Gear pin in bearing cap.

19 (b)

Fit internal circlip in Bottom Intermediate Gear & press Ball Bearing from both sides .

# 19(c)

Place spacer before fitting the BIG on pin & fit circlip on both ends of pin

## Step 20

Fit all Main Bearing Caps with M14x1.5 nuts & torque up to 12 Kg m. Check the free rotation of crankshaft.

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## METHOD OF CHECKING CRANK SHAFT END PLAY To determine amount of crankshaft end play slide the crankshaft back and forth . **The end play should be 0.125- 0.387**



## **Step 21** Piston Ring End Gap

Piston Dia	I	Ш	III
100 mm	0.25-0.45	0.60-0.80	0.35-0.55
105mm	0.25-0.45	0.60-0.80	0.30- 0.55

## Step 22

Piston Ring to piston Ring Groove Axial Clearance

Piston Dia	I	II	III
100 mm	0.075-0.095	0.070-0.110	0.030-0.070
105mm	0.085-0.113	0.03-0.0.07	0.03-0.07

## Step 23

Fit all piston Rings in their respective grooves. Top Mark should on upside

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B-32

**Step 24** Fit big end bearing liner in connecting rod

**Step 25** Fit big end bearing liner in connecting rod cap.

# **Step 26** Assembled Con rod, Piston and piston pin and lock with circlips B-35.

**IMP:-** valve pockets and notching of Con rod should be in same side.

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B-33

## Step 27 Place special tool above cylinder liner to drop piston assembly into Cyl liner.

Step 28

Slide in the piston & con rod assy. by gently pushing piston down. Fit all piston assemblies in same manner. **IMP :- Keep valve pockets towards cam shaft side.** 

#### Step 29

Place Con rod cap and Screw all conrod nuts by hand throughout the length and then torque all CR nuts using torque wrench (8-9 Kg m) IMP: - Ensure proper cleaning of nut and bolts and end play of con rod after assy.

• Marking on cap and con. rod should on same side.

Step 30 Assembly Procedure of Hyd. Pump drive shaft

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Assemble two ball bearings in HPD shaft with circlip

Press Ball Brg. 6007 in HPD shaft Fit Circlip A30

Press 2nd Ball Brg. 6206 with circlip in HPD shaft. Fit Key.6x6x20 in HPD haft

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**Step 31** Fit two grub screws









Fit HPD shaft assy in crankcase and tighten it with retainer by using three ScrewsM8x14.







Fit HPD shaft gear in such a manner that Projected side of gear should be towards the crankcase (as shown in Fig.) and tighten it with nut M30x1.5.

Step 34 Screw valve lubrication bolt (M10x1.5) & lock it with nut M10.

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SERVICE MANUAL

B-36

Properly clean the cam shaft and fit radial ball bearing (6006) Ensure that cam lobes and journels don't heavy scoring & abnormal wear.

## Step 36

Step 37

crankcase side.

Fit key 6x6x20 and slide cam shaft in the respective bore of Crankcase . IMP:- Check free rotation of camshaft

Lubricate Cam shaft before fitting in Crankcase

Tighten cam shaft retainer by using 3 Screws M8\*14. Ensure that step side of retainer should face towards









## Steps 38

Fit cam shaft gear & place plane washer on it & tighten it with special bolt M10x1.5. Torque upto 4 kg.

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B-37

Step 39 Take IPD shaft and clean it properly.

Step 40 Press radial ball bearing (B/B) 35/62\*14(6007) on IPD shaft.

**Step 41** Fit External circlip A-35 in front of bearing.

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Step 42

Fit second radial ball bearing 30x62x116 (6206 NR) and then fit key 6x6x20 in front of bearing in the IPD shaft.









**Step 43** Slide the IPD shaft in the respective bore. IMP:- Lubricate Bearings before Assy.

Step 44

Place the IPD Retainer and Tight three M8x16 Screws along with spring washers.

**Step 45** Fit IPD gear & light with lock nut M30x1.5.

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Step 46

Fit FIP Timing gear directly on FIP and tighten it with special adopter. ( In case of Direct Mounted FIP's )

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Lubricate TIG & fit in such a way that its timing mark match with cam gear, crank gear & FIP Timing Gear .









cating bolt to TIG pin.

SERVICE MANUAL

**Step 48** Place lock plate over TIG and tight it with bolts M8x45.

Step 49

Fit tube assy. from lubricating bolt to TIG pin.

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B-40

# **VALVE TIMING -**

The camshaft and the fuel pump gears are driven by crankshaft gear through an idler gear. All the gears are suitably marked during production to facilitate re-timing. The marks being in line when no. 1 piston is at top dead center on its compression stroke. The timing marks does not align at every rotation of the crankshaft where no. 1 piston is at TDC compression. It is necessary to replace any of the timing gears, ensure that there is a backlash between 0.05 to 0.35 (wear-limit 0.9).

The timing or the resetting of the timing can be simply & quickly carried out with following instructions.

With the engine timing correctly set, the engine is turned until no.1 piston is at TDC on its compression stroke. In this position align center punch marked on the gear with the center punch mark on camshaft, fuel pump and crankshaft gear respectively.

It should be noted that no adjustment is provided for valve timing. Provided the gear is correctly fitted.



# **GEAR BACKLASH CHECKING**



Dial Gauge Pointer Set at Zero & Check Backlash



Timing Gear Back lash of all gears should be 0.05-0.35 (WEAR-LIMIT 0.9)

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Fit Straight connection in the crankcase alongwith sealing washer (18x24x1.5 cu)

## Step 51

Fit the lubrication oil pump assy to Front Brg. Cap using bolt M10x130. (Use 0.1mm shim to adjust Backlash if required.)Torque the bolt up to 3-4 kg m with torque wrench.



Step 53 Fit suction strainer to neck for screw and tight propnly

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Fit reduction valve assy and delivery pipe using sealing rings (cu18x24x1.5) to oil pump IMP- Always use new sealing washers

Step 55 Fit other end of delivery pipe to connection IMP :- Tight all joints properly.

## Step 56

Tight suction strainer and Sheet metal cover using screws M8x14and spring washer B8

## Step 57

Clean Rear cover and fit main oil seal 120x140x15 into rear cover . IMP :- Lubricate oil Seal before Fitment

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#### SERVICE MANUAL

B-44

Gently press 2 dowel pins in Crankcase. and Place Rear cover gasket and Rear Cover .

# Step 59

Place Rear cover gasket using sealent & Tight rear cover using five screws of M8x25 and 2 screw M8x30 alongwith spring washer . IMP:- Place rear cover carefully on crankcase to avoid seal damage.





#### Step 60

Fit oil channel Plug M18x1.5 using sealing washer18x24x1.5 (Cu) & sealent to plug main oil gallery from rear side

**Step 61** Fit splash guard on front side of Timing Gear on crank shaft

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Step 62
(1) Screw 8 Studs in front face of crank case
6 studs of M16\*59
2 studs of M16\*64
(and fit 2 locating hollow dowel in case of SGI front cover.)

And 2 locating dowel pins in case of CI front Cover

# Step 63

Clean front cover properly . Place the front cover gasket and front cover on the locating dowels and tighten with following fasteners For SGI Front Cover (Bigger) 8 NUTS M16x2 8 Spring washer B16 1 Bolts 10x55 4 Bolts 10x55 4 Bolts 10x50 3 cap head screw 5 Spring washer B-10 FOR CI front cover (Small)

10 bolts M10\*50 1 bolt M10\*55 3cap head screw 11 Spring washers B-10

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**Step 64** Fit front cover oil seal Dia. 52x72x12. in Front Cover and lubricate oil Seal.

Step 65

Fit Transmission elbow with gasket using two screw of M8x20 and spring washer B-8

## Step 66

Fit cover for front cover (FIP Side) with three screws M8x16 and spring washers B-8

## Step 67

Fit Engine Belt Pulley carefully aligning Keyway and Key. Tighten crank pulley using nut M32x1.5 & torque up to 25Kg-m.

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# SERVICE MANUAL

B-47

Heat the ring gear upto  $110^{\circ} - 120^{\circ}$  and place on flywheel and let it cool

Step 69 Align the Flywheel dowel hole with Dowel of Crankshaft and push in

**Step 70** Tighten Flywheel using four hex bolts M12x38 and torque it (8-9 kg-m)

## Step 71

Place oil pan Gasket, oil pan and side bars. Tight all alongwith spring washers & Screws of oil pan

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**Step 72** Fit oil drain plug using Sealing washer (20x26x1.5 cu)

Lubricate rocker arm pin and fit it to rocker arm bracket. Fit Rocker Arm pin to Rocker arm bracket.

Step 74 Lubricate rocker arm and assemble both Rocker Arms

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B-49

Step 75

Fit external circlip (A-22) in the groove on the both sides of Rocker arms after placing washer.









**Step 76** Fit two adjusting screws. and Lock nuts in all Rocker Arms.

Step 77 Properly clean cylinder head and press valve guides .

# Step 78

Slide inlet and exhaust valves in their respective valve guides. Lap valve seats with fine lapping paste and clean the valves after lapping. IMP :- Lubricate valve during Assembly.

**Step 79** Press Valve oil seal in both Guides. **IMP:-** Ensure proper fitting of oil seal spring

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Step 80 Place, inner and outer valve springs

Step 81 Place valve Retainer cap & fit valve cotters properly with fixture

Step 82

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Gently press dowel sleeves on top face of Crankcase with soft hammer

## Step 83

Fit the studs M10\*30 in Cyl. Head for exhaust flange mounting. and place exhaust flange gaskets.

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**Step 84** Place Cyl. Head gasket on respective bores

Step 85 Place Cyl. Head assy on Crank case properly.

# Step 86

Tighten cyl. head assemblies using Hex Bolts M16x2x128 Torque the bolts (22Kg-m). IMP:- Ensure Diagonal sequence of tightening.

Step 87 Place tappet and slide in Crank case. IMP :- Ensure Free Movement.

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SERVICE MANUAL

B-52

**Step 88** Place push rods on all tappets..

Step 89

Place rocker arm sub-assembly and tighten it to cylinder head using bolt (M8x65) and support stud M8 along with spring washer B-8.

**Step 90** Set tappet clearance using feeler gauge.

Step 91 Fit stud M8 for injector fitment for each Cyl head .

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Fit Inlet manifold with gaskets and tight with M8\*20 and B8 spring washer for sheet metal Inlet manifold & M 8x100/M 8x45 for AI. Inlet Manifold

Step 93

Fit water return line using M8x35 and M8x55 bolts and spring washers.

Place valve cover along with gasket. Place dowty washer & special nut









#### Step 95

Step 94

and tight to 0.4-0.5 Kg m Torque.

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Place grommet in inner side of side cover and mount Side cover along with gasket and tight by using M10 bolts alongwith O- ring 10x2 and plain washer.

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B-54

Fit breather pipe with side cover using banjo bolt B-13 along with sealing washer (18x24x1.5 CU).

Step 97

Mount exhaust flange and tighten it with M10nuts and B10 washer . Fit two studs M10\*30 in exhaust flange for exhaust elbow mounting.



Place injector along with sealing washer in each cyl head and tighten Injector clamp alongwith conical washer and M8 nut. Tight M8 nut properly.

#### Step 99

Fit water pump along with gasket to front side of crankcase using 3 bolts M10x35 and spring washer B-10 & one bolt of M10\*40 and tight properly.

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Fit thermostat valve with hose pipe (water pump to thermostat and thermostat to water return line) tighten hose clamps. Properly

Step 101

Push gently centering guide along with sealing rings 14x2 in crank case

#### Step 102

Fit oil filter body on crankcase along with Gasket .Screw M10x25 screws & mount oil filter body

#### Step103

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Fit oil tube assy. With banjo bolt B-13 using sealing washer (18x24x1.5 CU) from oil filter body to close








Step 104

Assembly procedure of FIP with IPD shaft Place the FIP gaskets on Crankcase.

**Step 105** Fit Circlip in coupling bush

#### Step 106

Place coupling bush on IPD shaft in such a way that larger teeth of coupling bush meshes with respective teeth of IPD shaft.

#### Step 107

Mount Coupling gear on FIP shaft And tight properly and Torque the coupling Gear upto 6 Kg-m.

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#### SERVICE MANUAL

B-57

#### Step 108

Align missed tooth of Coupling Gear and Big tooth of Coupling Bush and push FIP to crankcase.

**Step 109** Gently tight fuel injection pump using three M10 nut, plane & B10 washer.

**Step 110** Procedure for FIP Timing. Remove delivery valve holder to take out delivery valve.

Step 111 Remove delivery valve.

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SERVICE MANUAL

B-58

**Step 112** Tighten delivery valve holder

Step 113

Fit spill cut pipe as shown and fuel inlet pipe to FIP. While pressing priming pump fuel will start flowing from spill cut pipe .

#### Step 114

Rotate Flywheel in clockwise direction and bring it to 14° mark & ensure that fuel flow stops with continous pressing of priming pump.

#### Step 115

Fit Fuel Filter assy to crankcase using Hex bolt M10\*30. and assemble fuel pipe with banjo bolt with sealing washer (Cu) after proper cleaning.

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#### Step116

Set FIP inward and outward and adjust when diesel flow will stop , this is the point of Fuel Injection timing

Step 117 Tight 3 FIP nuts M10 Firmly

**Step 118** Put delivery valve in its place and torque delivery valve holder up to 4-5 kg m.

and Fit high pressure pipes and fuel pipes.

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**Step 119** Screw the dipstick in the respective M10 hole of crankcase with Rubber ring

Step 120

Fit Breather assy. on front cover. Ft metallic breather assy with 2 breather pipes (For Comp. Housing Engine) with M8\*14 Screws.

**Step 121** Fit starter motor after placing gasket using M10\*30 and spring washer. B10

**Step 122** Fit alternator Mtg. Bracket to Crankcase with 10x20 screws and Spring washer B10.

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B-61

Step 123 Mount alternator with mounting . bracket using M10x70 bolt & nylock nut.

Step 124 Fit Alternator strut front to alternator using bolt M10

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#### (20) (21) (22 23) 24 (25) (26) (27) (28) 29) (30) (31) (35) (33) (43) (42) (41) (40) 36 (39) (38) (37)

LONGITUDINAL SECTION

#### S.NO. DESCRIPTION

- THERMOSTAT ASSY. 1
- VALVE OIL SEAL 2
- 3 VALVE COTTER PAIR
- 4 VALVE SPRING RETAINER CUP
- ROCKER ARM BRACKET ASSY. 5
- WASHER SEAL 6
- 7 VALVE COVER
- 8 VALVE COVER NUT (M8)
- VALVE INNER SPRING 9
- 10 VALVE OUTER SPRING
- 11 LOWER VALVE SPRING RETAINER 31
- 12 EXHAUST VALVE
- INLET VALVE 13
- 14 PISTON
- 15 **PISTON RING (1ST)**
- 16 PISTON RING (2ND)
- 17 **PISTON OIL RING**
- 18 PISTON PIN
- 19 FLYWHEEL RING GEAR
- MAIN OIL SEAL MAIN OIL SEAL 40 20

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#### S.NO. DESCRIPTION

- 21 FLYWHEEL BOLT
- 22 THRUST BEARING (TOP-2)
- 23 THRUST BEARING (TOP-1)
- 24 BEARING LINER (REAR TOP)
- 25 BEARING LINER (REAR BOTTOM)
- 26 THRUST BEARING (BOTTOM-2)
- 27 BEARING CAP STUD
- 28 FLYWHEEL
- 29 REAR RING GEAR
- 30 REAR BAR
  - REAR COVER GASKET
- DRAIN PLUG 32
- 33 SHEET METAL COVER
- 34 THRUST BEARING (BOTTOM-1)
- 35 CON. ROD BIG END LINER
- 36 BEARING LINER BOTTOM
- 37 BEARING LINER (TOP)
- 38 CRANKSHAFT
- 39 SUCTION STRAINER
- NECK FOR SCREWING IN

#### S.NO. DESCRIPTION

41 OIL PUMP ASSY

(32

- **OIL PAN SHEET METAL** 42
- 43 FRONT COVER
- 44 BOTTOM INTERMEDIATE GEAR
- TIMING GEAR (CRANK) 45
- FRONT OIL SPLASH GUARD 46
- FRONT OIL SEAL 47
- CLAW NUT 48
- 49 ENGINE BELT PULLEY
- 50 BOLT M10X1.5
- CAMSHAFT 51
- CAM GEAR 52
- 53 WATER PUMP ASSY.
- 54. HOSE RADIATOR TO WATER PUMP
- 55 RADIATOR
- 56 HOSE THERMOSTAT TO RADIATOR
- SERVICE MANUAL

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#### S.NO. DESCRIPTION

- 1 RETURN LINE
- 2 EXHAUST ELBOW
- 3 TURBO CHARGER
- 4 ALTERNATOR MOUNTING BRACKET
- 5 HOSE RETURN LINE TO THERMOSTAT

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- 6 FAN ASSY.
- 7 ALTERNATOR ASSY
- 8 SPACER
- 9 ENGINE BELT PULLEY
- 10 POWER STEERING PUMP
- 11 OIL PAN
- 12 LUB OIL FILTER

#### S.NO. DESCRIPTION

- 13 HEAT EXCHANGER
- 14 CRANKCASE
- 15 FLYWHEEL
- 16 HYDRAULIC PUMP
- 17 SIDE COVER
- 18 CYLINDER HEAD CASKET
- 19 CYLINDER HEAD
- 20 EXHAUST MANIFOLD
- 21 VALVE COVER GASKET
- 22 VALVE COVER
- 23 WATER TEMP SENSOR

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## FAULT DIAGNOSIS CHART

FAULT	POSSIBLE CAUSE
Low Cranking speed	1, 2, 3, 4
Starting Problem	5, 6, 8, 9, 10, 12, 13, 14, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 22, 24, 29, 31, 32, 33
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 22, 23, 24, 25, 26-, 27, 31, 32, 33
Misfiring	8, 9, 10, 12, 13, 14, 18, -, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33
Black Smoke	11, 13, 14, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33
Blue & White Smoke	4, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 59
Knocking	9, 14, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 60
Erractic Running	8, 9, 10, 11, 12, 13, 14, 20, 23, 26, 28, 29, 30, 33, 35, 45
Vibration	13, 14, 20, 23, 25, 26, 27, 29, 30, 33, 45, 48
High Oil Pressure	4, 38, 41
Over Heating	11, 13, 14, 18, 19, 24, 25, 45, 47, 50, 51, 52, 53, 55, 58
Excessive Blow By	25, 31, 33, 34, 45, 56
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 60
Starts and Stops	10, 11, 12

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# **KEY TO FAULT DIAGNOSIS CHART**

1Battery Capacity Low2Bad Electrical Connections3Faulty Starter Motor4Incorrect Grade of Lub. Oil5Low Cranking Speed6Fuel Tank Empty8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	1	Dettern Conseit / eur						
2Bad Electrical Connections3Faulty Starter Motor4Incorrect Grade of Lub. Oil5Low Cranking Speed6Fuel Tank Empty8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores								
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4Incorrect Grade of Lub. Oil5Low Cranking Speed6Fuel Tank Empty8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	3	Faulty Starter Motor						
5Low Cranking Speed6Fuel Tank Empty8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	4	Incorrect Grade of Lub. Oil						
6Fuel Tank Empty8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	5	Low Cranking Speed						
8Blocked Fuel Lift Pump9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	6	Fuel Tank Empty						
9Faulty Fuel Lift Pump10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	8	Blocked Fuel Lift Pump						
10Chocked Fuel Filter11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	9	Faulty Fuel Lift Pump						
11Restriction in Air Cleaner12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	10	Chocked Fuel Filter						
12Air in Fuel System13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	11	Restriction in Air Cleaner						
13Faulty Fuel Injection Pump14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	12	Air in Fuel System						
14Faulty Atomizer or Incorrect Type17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	13	Faulty Fuel Injection Pump						
17Broken Fuel Injection Pump Drive18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	14	Faulty Atomizer or Incorrect Type						
18Incorrect Fuel Pump Timing19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	17	Broken Fuel Injection Pump Drive						
19Incorrect Valve timing20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	18	Incorrect Fuel Pump Timing						
20Poor Compression22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	19	Incorrect Valve timing						
22Incorrect Type or Grade of Fuel23Sticking Throttle or Restricted Movement24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	20	Poor Compression						
<ul> <li>23 Sticking Throttle or Restricted Movement</li> <li>24 Exhaust-Pipe Restriction</li> <li>25 Cylinder Head Gasket Leaking</li> <li>26 Over Heating</li> <li>27 Cold Running</li> <li>28 Incorrect Tappet Adjustment</li> <li>29 Sticking Valves</li> <li>30 Incorrect High Pressure Pipes</li> <li>31 Worn Cylinder Bores</li> </ul>	22	Incorrect Type or Grade of Fuel						
24Exhaust-Pipe Restriction25Cylinder Head Gasket Leaking26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	23	Sticking Throttle or Restricted Movement						
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26Over Heating27Cold Running28Incorrect Tappet Adjustment29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	25	Cylinder Head Gasket Leaking						
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<ul> <li>28 Incorrect Tappet Adjustment</li> <li>29 Sticking Valves</li> <li>30 Incorrect High Pressure Pipes</li> <li>31 Worn Cylinder Bores</li> </ul>	27	Cold Running						
29Sticking Valves30Incorrect High Pressure Pipes31Worn Cylinder Bores	28	Incorrect Tappet Adjustment						
30Incorrect High Pressure Pipes31Worn Cylinder Bores	29	Sticking Valves						
31 Worn Cylinder Bores	30	Incorrect High Pressure Pipes						
	31	Worn Cylinder Bores						

32	Pitted Valves and Seats
33	Broken, Worn or Sticking Piston Ring (S)
34	Worn Valves Stems and Guids
35	Overfilled Air Cleaner or use of incorrect grade of oil
36	Worn or Damaged Bearings
37	Insufficient Oil in Sump
38	Inaccurate Gauge
39	Oil Pump Worn
40	Pressure Relief Valve Sticking Open
41	Pressure Relief Valve Spring Closed
42	Broken Relief Valve Sticking Closed
43	Faulty Suction Pipe
44	Choked Oil Filter
45	Piston Seizure/Pick Up
46	Incorrect Piston Height
47	Damaged Fan
48	Faulty Engine Mounting (Housing)
50	Faulty Thermostat
51	Restriction in Water Jacket
52	Loose Water Pump Drive belt
53	Choked Radiator
55	Faulty Water Pump
56	Choked Breather Pipe
58	Coolant Level Too Low
59	Blocked Sump Stainer
60	Broken Rings

# LUBRICATION SYSTEM

#### **SPECIFICATIONS**

Lubricating syste	m	Force-feed type			
	Туре	Gear type			
	Regulating valve opening pressure	5 <sup>±0.5</sup> kg/cm <sup>2</sup>			
	Туре	Paper filter			
	Oil Filter relief valve opening pressure	1.5 kg/cm <sup>2</sup>			
Oil cooler	Type / Regulating valve opening pressure	Water cooled / 4.0 kg / cm <sup>2</sup>			
Total oil capacity		11 Liters(4 cyl.)			
Oil pan capacity		5 liters (4 cyl.)			
Oil filter capacity		0.5 liters			
Engine Oil		SAE-20 W. 40*			

#### TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	ACTION TO BE TAKEN				
	Loosely installed parts	Tighten or replace				
	• Drain plug					
Oil leakage	• Oil filter					
	Faulty seal and gasket	• Papair or replace				
	Timing gear case - Cylinder block					
	• Oil leakage	Refer to oil leakage				
	Insufficient oil	• Replenish				
	Wear and damage on oil pump rotor/gears	Replace				
	Worn out plunger or spring	• Replace				
	Clogged oil strainer	Replace				
	Excessive oil clearance of bearing	• Repair				

\* Engine oil grade should be change as suitable to operating atmospheric condition.

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#### **SPECIFICATIONS**

Cooling method		Water cooled
Coolant Capacity (ITL Engine 3cyl - 4cyl)		9.5 liters - 13 liters
Thermostat	Туре	Wax type
	Opening temp.	$74^{\circ}C \pm 2^{\circ}C$
	Full open temp.	$90^{\circ}C \pm 2^{\circ}C$
	Full open lift	9.5 mm (min)
Water	Туре	Vane type centrifugal
Pump	Driving method	Belt driven
	Туре	Corrugated
Radiator	Cap valve	0.9 kg/cm <sup>2</sup> - 0.9 kg/cm <sup>2</sup>
	Opening pressure	
	Туре	Direct coupled (Axial flow)
Cooling fan	Number of blades	6 x 400 mm Sheet Metal,
	x outer dia.	7 x 420 mm - DI 90

#### TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	ACTION TO BE TAKEN
Coolant leakage	Damaged radiator core	Replace
	Coolant leakage from radiator hose	Correct or replace
	Coolant leakage from Thermostat	Correct or replace
	Faulty seal (water pump)	Replace
	Loose or damaged thermostat cover gasket	Correct or replace
	Loose cylinder head blots	Tighten additionally
	Damaged cylinder head gasket	Replace
	Cracked cylinder block	Replace
	Cracked cylinder head	Replace
Corrosion	Impurities are mixed in the coolant	Clean
Overheating	Clogged water passages	Clean
	Malfunctioning of thermostat	Replace
	Clogged radiator fins	Clean
	Malfunctioning of water pump	Correct or replace
	Loose or broken fan belt	Adjust or replace
	Insufficient coolant	• Add
Coolant temp.	Faulty thermostat	Replace
dose not		
increase		

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#### THERMOSTAT

#### **REMOVAL AND INSTALLATION**

- 1. Drain coolant into a suitable container.
- 2. Remove each part in sequence as given below.
  - (1) Upper radiator hose
  - (2) Thermostat cover
  - (3) Gasket
  - (4) Thermostat
- 3. Install in the reverse order of removal.



FIG. 1

#### **INSPECTION**

Check operation and replace if necessary

- 1. Visually check valve to make sure it is air tight.
- 2. Place thermostat and a thermometer in water.
- 3. Heat water gradually.
- 4. Check initial valve opening temperature, fully open temperature and fullyopen lift.

Initial opening	$74^{\circ}C \pm 2^{\circ}C$			
temperature				
Fully-open	$90^{\circ}C \pm 2^{\circ}C$			
temperature				
Fully-open lift	9.5 mm (min)			



FIG. 2

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#### **COOLING SYSTEM CHECK**

- 1. Visually check each hose for cracks, and system expansion. Make sure that the hose band clamp is not loose.
- 2. Perform the pressure test.
  - 1. Remove the radiator cap, completely fill the radiator with coolant and set a tester.
  - 2. Warm up the engine.
  - 3. Stop the engine, apply pressure of 0.9 kg/cm<sup>2</sup> to the tester and check the following points.
  - Does the needle of the pressure gauge continuously point to the same valve ?
  - Is there excessive swelling in the hose?

#### NOTE

• When removing the tester, hot cooling water may blow out. The operator should protect himself from a scald by using an cloth, etc.



FIG. 1



FIG. 2



FIG. 3

#### **RADIATOR** CHECKING RADIATOR CAP PRESSURE VALVE

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Set a radiator cap tester on the radiator cap and ensure that the pressure valve functions properly at the specified pressure. Pressure valve opening pressure :  $0.5 - 0.9 \text{ kg/cm}^2$ 

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#### RADIATOR CAP AND VACUUM RELIEF VALVE

Open the valve by pulling it and make sure that it closes when released. Check and see the contact surface for any damage.

#### **RADIATOR DISMANTLING PROCEDURE**

#### **REMOVAL:-**

- 1. Remove the required sheet metal, Air cleaner & Electric wiring connection of head light & horn.
- 2. Drain water from radiator & open the filler cap.
- 3. Remove clamp of rubber house connecting from upper and lower tank.
- 4. Remove/loosen the Hex Lock nut from bottom part of the radiator.
- 5. Take out radiator from tractor in upward direction.

#### **INSPECTION:-**

- 1. Check radiator Tube/Joint/Tank for any leakage.
- 2. Check Radiator cap relief valve proper working & ensure for damage free rubber seal of radiator cap.
- 3. Check radiator fins for any damage.
- 4. Check radiator tubes are free from rust and clogging.

#### **MAINTENANCE :-**

- 1. Flush and clean the radiator properly.
- 2. Clean the clogging of fins by air blow without damaging fins.
- 3. Check and replace damaged hose pipe.
- Note : To avoid frequent radiator tube rusting and partial clogging of water jackets on account of scaling "USE OF ANTISCALE / ANTIRUST AGENT IS RECOMMENDED". Anti Rusting Cooling Agent (Veedol Zero) Part no:10026400AA

QTY.ML	MODEL				
300	4-CYL.IN HOUSE ITLENGINE				

5. Add Antifreeze in sub zero temperature operating condition.









FIG. 3

# TURBO CHARGER

#### ON VEHICLE INSPECTION TURBO CHARGER BOOST PRESSURE

- 1. Disconnect air hose from the wastegate.
- 2. Connect pressure gauge as shown.
- 3. Connect tachometer to the engine.
- 4. Warm up engine to operating temperature.
- 5. Increase engine speed to max rpm and check the boost pressure if it is within the specified limit.



FIG. 1

#### **TURBINE WHEEL**

- 1. Allow engine to cool.
- 2. Remove the air hose.
- 3. Verify that the rotor assembly turns smoothly.

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4. If there is excessive load or noise, replace the turbo charger.



FIG. 2

#### **OIL PASSAGE**

- 1. Allow engine to cool.
- 2. Remove oil return pipe.
- 3. Verify that carbonized oil has not blocked oil passage of the turbocharger and of oil return pipe.
- 4. If carbonized oil has blocked the oil passage replace turbochager and return pipe if necessary.

#### REMOVAL & INSTALLATION OF TURBO CHARGER

Remove turbo charger in a given sequence & install in the

reverse order.

- 1. Air intake hose
- 2. Air intake pipe
- 3. Oil inlet pipe
- 4. Oil outlet hose
- 5. Air outlet pipe
- 6. Front exhaust pipe.
- 7. Turbo charger.

Note : Turbo charger can only be repaired at authorised workshops. Special tools and expert knowledge is mandatory for its repairs.

Caution : Since the turbo charger is a precision equipment it should be handled with great care while removing and installing.

- a) In any case it should not be dropped.
- b) Do not use control valve as carrying handle to life the turbo charger.
- c) Cover the intake, exhaust, and oil passages of turbo charger to prevent entry of dirt other objects.

#### **INSPECTION**

After removing the turbo charger, check the oil feed and oil return for clogging. Replace if necessary.

#### DO'S AND DONT'S FOR SATISFACTORY FUNCTIONING OF TURBO CHARGER

#### DO'S

Change engine oil and oil filters regularly during service intervals.

Change/clean air filter element at every service.

Check for oil pressure at engine idling speed. The pressure should not drop beyond specified minimum pressure.

Give idle running for 2 minutes after starting the engine.

Run the engine for 2 minutes in idle condition before switching the engine off.

Regularly check air, oil and exhaust connection for leaks and abnormal dust/oil carbon deposit.

#### DONT'S

Don't run the engine with low oil pressure.

Don't put the engine under full load immediately after starting.

Don't switch off the engine under full load.

Don't run the engine with damaged, oil feed & drain pipes.

Don't run the engine with damaged/faulty connection, from air cleaner to turbo charger and from turbo-charger to inlet manifold.

Don't run the engine with damaged/faulty connections to the turbo-charger turbine inlet and from turbine outlet. Don't use the control valve for lifting the turbo-charger.



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ART		required	required	required	r tighten the	ooler or tigl	as required	of the obje	reauired	irts or tighte	required.	her	s required	s required		al engine			correct the ack of oil enter into
TURBO CHARGER ROUBLESHOOTING CH	Replace air filter element	Remove restriction or replace damaged parts as	Remove restriction or replace damaged parts as	Remove restriction or replace damaged parts as	Arrest the leak by replacing hoses, clips, pipes or clamos as required	Arrest the leak by replacing hoses, clips, pipes, c the clamps as required	Arrest the leak by replacing gaskets or fasteners	Remove the object & check for the cause / origin	entry & correct it Remove restriction or replace damaged barts as	Arrest the leak by replacing gaskets/damaged pa the fasteners as required	Remove restriction or replace defective parts as r	Remove restriction & clean the crank case breath	Change oil & oil filter, service or replaced turbo a:	Check & arrest the faults and replace or adjust as	Adjust correct timing	Replace the worn-out components & rectify interr problems	Refer to turbo charger authorised service center	Refer to turbo-charger authorised service center	Refer to turbo charger service center, analyze & cause of failure (turbo failure is normally due to Is low oil pressure. dirt in engine oil. foreign pratice
F			g			σ		ą					b					σ	
		sor Inlet	ressor outlet		mpressor	intake manifo	inder head	d/intake duct		cylinder heac			central housi			ternal engine	en position	iage/puncture	
ģ	2	to compres	s from comp		lean and co	npressor & i	fold and cyli	aust manifol		anifold and	il drain line	breather	bo charger	njections		gs, liners, in )	struck in op	sembly dam sition	
	lement	Intake duct	outlet ducts	ke manifold	tween air c	etween cor	ntake mani	engine exha	t svstem	exhaust m	o charger o	crank case	coke in tui	n pump & I	ing	, piston rin ed blow-bv	ntrol valve	be/hope as closed pos	laged
	ed air filter e	ctions In air	ctions in air manifold	ction in intak	ak in duct be	ak in ducts b	ak between i	jn object in ∈	ressor cted exhaus	eak between	ction in turbo	cted engine	oil sludge or	r fuel injectio	per valve tim	mout valves	pressure co	pressure pig alve stuck in	charger dam
Boost pressure too high	Cload	Restri	Restri intake	Restri	Air lea	Air lea	Air lea	Foreiç	comp	Gas le	Restri	Restri	Thick	Faulty	Impro	Worol	Boost	Boost and v	Turbo
Oil leak from furbi:	+	$\vdash$					$\vdash$				•	•	•			•		•	
	┛	•							•		•	•	•			•			•
Blue smoke	╞		•	•	•	•	•	•		•							-		•
Excesive engine and	┦			-									•				+		
Black exhaust o	╎		•	•		•		-					•	•	•	•			•
Engine lacks	╞	F	•								⊢	$\vdash$							

#### 1.0 GUIDELINES FOR DRY AIR CLEANER

- Clean the primary element after every 300 hrs of operation or when ever choke indicator glows on dashboard.
- Replace primary element after 3 time cleaning or 900 hrs (whichever earlier).
- Gently pull primary element back and forth to take it out from housing.
- Clean primary filter element by blowing air (max. pressure) from inside.
- Safety cartridge not to be removed during cleaning of primary element. Safety cartridge to be replaced after every three replacement of primary filter.
- Do not clean safety cartridge by compressed air.
- Use clean cloth to wipe sealing areas of primary filter.
- Ensure proper seating of filter into housing before latching the cover. Do not use latches on the cover to force the filter into air cleaner that could cause damage to housing and will void the warranty.
- Ensure proper seating of all rubber rings replace the damages ones.



**NOTE** Clean the primary filter whenever choke indicator glows on dashboard.

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# CLUTCH

С

### CONTENTS

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SERVICE MANUAL

С

#### **C1.0 INTRODUCTION**

The clutch works on the principle of friction in which when one stationary surface is brought into contact with a rotating surface, the stationary surface also starts rotating. In actual practice one of the driving plates is the flywheel and the other is known as the pressure plate. The driven plate is a clutch plate made of frictional material and directly mounted on the splined end of the clutch shaft. In normal running condition the pressure springs keep the pressure plate in contact with the clutch plate. When the foot pedal is pressed, the pressure plate moves away against the pressure springs allowing the clutch plate and thus the clutch shaft to become stationary.

Depending on the design, it may have a single disc or two disc, one for the main transmission and the other for power take off (PTO).

#### C 2.0 FUNCTION

A clutch is a device that is used to transmit between an input and output shaft that operate at different speeds. A clutch cannot multiply torque like a clutch torque converter. The torque output from a clutch will always equal the torque input. When the clutch is slipping, the output torque is still equal to the input torque but power is lost (in the form of heat) because the output RPM is lower than the input RPM.

#### C 3.0 WORKING

The main components are as under :

- CLUTCH PLATE
- PRESSURE PLATE
- CLUTCH COVER
- PRESSURE SPRINGS
- RELEASE FINGERS
- RELEASE BEARINGS
- CLUTCH SHAFT
- LINKAGES.

The clutch cover is bolted to the flywheel, and the clutch plate is mounted on the splined part of the clutch shaft, the front end of which is freely supported on the pilot bearing fitted in the flywheel and other passes through the release bearing. In between the pressure plate and the clutch cover, pressure spring are placed all around the circumference. Three fingers, also known as release levers, are centrally fulcrum to the clutch cover with their outer ends connected to the pressure plate. A release bearing slightly away from the free ends of the fingers moves to and fro on the clutch shaft with the hello of a fork, which is connected to the clutch pedal through the linkages. As soon as the pedal is pressed, the release bearing moves towards the flywheel and presses the fingers. As the fingers are fulcrum at a point in their length to the clutch cover and the other end is connected to the pressure plate as soon as the free ends are pressed inside by the release bearing, the outer tends to bring the pressure plate away from the clutch plate against pressure springs, making the clutch plate hence the clutch shaft to disengage. But the pressure plate and cover remain rotating along with the flywheel. Thus the condition of disengagement remains till the front pedal remains pressed. As soon as pedal returns to the engaged position, the pressure plate moves ahead to press the clutch plate due to the pressure springs.

#### **C 4.0 SPECIFICATAIONS**

TRACTOR	4-CYL							
MODE	DOUBLE CLUTCH							
CLUTCH	DRY MECH	DRY MECH						
MAKE	LUK INDIA	LUK INDIA						
ТҮРЕ	DUAL SEPARATE CONTROL							
DRIVE DISC	1	1						
LINING	ORGANIC	CERAMIC						
DIAMETER	280	280						
CONTROL	MECH	MECH						



#### C 5.0 DETAIL OF DOUBLE CLUTCH LINKAGE ASSY PARTS

S. NO	DESCRIPTION	Qty
1	DISC PUSHER	1
2	BEARING	1
3	SLEEVE PUSHER	1
4	BEARING	1
5	SLEEVE	1
6	PLUG	1
7	SLEEVE	1
8	SUPPORT	1
9	BOLT M8X25	3

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S. NO	DESCRIPTION	Qty
10	BEEARING	1
11	SNAP RING D50	1
12	SPLIT PIN 5X14	4
13	CLUTCH CONTROL FORK	1
14	LEVER	1
15	PIN 10X45	4
16	CLUTCH CONTROL FORK	1
17	LEVER	1
18	O.RING	1

#### C. 6.0 ASSEMBLY PROCESS OF DOUBLE CLUTCH

1. Insert the main clutch disc into the engine.

2. Attach the Clutch with PTO disc assy. To the engine with the help of 12 MB screws along with the spring washers with Pneumatic gun having socket of 13mm and torque wrench of 29Nm.

3. Check the setting of the fingers, Upper main clutch (35 to 36) and lower P.T.O (27 to 28) in the pressure plate in this D. C. engine with the help of if Vernier Caliper/depth Gauge.









#### **C 7.0 INSPECTION PROCEDURE**

#### A- CLUTCH DISC

#### **B- CLUTCH COVER**

#### A) CLUTCH DISC

#### CHECKING

- Hardened facing or oil on the facing.
- Use sand paper to rectify minor hardening.

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- Fatigued torsion springs.
- Loose facing rivets.
- Worn Clutch disc.

Note : Measure the depth of the rivet head of disc. Allowable limit up to 1.6 mm (FOR ALL SOLIS-III MODELS)

#### B) CLUTCH COVER

#### CHECKING

Fatigue and breakage of the diaphragm spring and breakage of the cover.Streaks, cracks and discoloring of the pressure plate in contact with the disk.Note : Minor straks and discoloring can be repained by polishing with send paper.

#### C 8.0 TROUBLE SHOUTING

S. No	PROBLEM	PROBABLE CAUSES	REMEDIES
1	Noise while pressing	Lack of lubrication in Clutch Release Bearing	Lubricate
	the clutch pedal	Clutch Release Bearing damage	Replace
2	Noise while releasing	Lack of lubrication in Pilot Bearing	Lubricate
	clutch pedal	Pilot Bearing damage	Replace
		Clutch disk hub loose on Input shaft	Replace the worn out parts
		Clutch Pedal free play	Adjust & correct (25 to 35 mm)
		Broken or Weak pressure spring	Replace springs
		Release lever height incorrect	Adjust & correct (SC. 40 to 44mm)(DC 28to36mm
		Grease or oil on facings	Replace the facing, check source of
3	Clutch slipping		grease or oil leak and arrest
		Glazed clutch facing	Replace facing
		Glazed flywheel or Pressure plate face	Correct by machining or replace
		Wraped Clutch facing	Replace the clutch facing
		Wraped Flywheel or Pressure plate face	Correct by machining or replace
1	Clutch not disengage	Clutch Pedal free play more	Adjust & correct
-	while pressing clutch	Release lever height setting improper	Adjust & correct
		Driver Clutch pedal riding	Keep foot off clutch pedal
		Excessive and incorrect use of clutch	Reduce use
5	Wear of clutch facing	Cracks in flywheel or pressure plate face	Correct by machining or replace
		Weak or broken pressure spring	Replace spring
		Clutch pedal free play less	Adjust & correct
		Lack of lubrication in pedal linkage	Lubricate
6	Clutch pedal hard	Clutch pedal jam on clutch shaft	Grease the shaft
		Release lever height setting improper	Adjust & correct
		Engine and Transmission not improper	Realign
		Flywheel face run out more	Correct run out or replace
7	Clutch pedal pulsation	Release lever not evenly adjusted	Adjust & correct
		Pressure plate assembly misaligned	Realign
		Warped pressure plate or clutch facing	Replace
		Clutch plate nut free on	De and check clean
		Workest clutch facing	

# D

# **FLOOR AREA & GEAR BOX**

# CONTENTS

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D 4	FILLING AND CHECKS	D-26
D 5	SERVICE SCHEDULE	D-29

ITL SERVICE MANUAL

#### D 1A. SHEET METAL

#### **Dismantling of Canopy**

For removing the canopy from the tractor remove hex bolts and hex M10x1.5x40, and stud mtg with trumpet housing size M16X1.5.And remove all the pins fitted on canopy.

#### **Assembling of Canopy**

To assemble canopy on tractor ensure that rubber pads are Fit on both of the sides of Trumpets Housing, Fit hex bolts M10x1.5x40, and stud mtg with trumpet housing size M16X1.5.And fit all the pins fitted on canopy.



#### **Disassembling of Fender assembly**

To dismantle fender assembly remove Nut/bolts M10x1.5x40, and stud size M16X1.5.

#### Assembling of Fender assembly

To assemble fender assembly keep rubber pads on trumpet housing fit Nut/bolts M10x1.5x40, and stud size M16X1.Ensure all nut/bolts are properly tighted.

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D-1 SERVICE MANUAL

#### **Disassembling of Floor Rear assembly**

To dismantle Floor assembly please remove fender assembly of both sides afterwards disconnect all the connections (Linkages) like brake connection , gear levers , hydraulic linkage connections , afterwards nuts mtg with rear housing.

#### Assembling of Floor Rear assembly

To assemble Floor assembly please tight all the nuts and bolts of floor assembly on rear housing please connect all the connections (Linkages) like brake connection, gear Levers, hydraulic linkage connections the all nuts/bolts after that fit fender assembly of both sides.

#### **Disassembling of Floor Front assembly**

To dismantle front floor assembly please remove its footstep. Afterwards remove front top assembly, RHS assembly and LHS assembly by removing Hex head screw M8X1.25-25 8-8 SA2JS.

#### Assembling of Floor Front assembly

For assembling of front floor assembly first of all fit LHS front floor assembly afterwards RHS and Top front floor assembly. After that fit Foot step.



#### D-2





#### D.1 Tightening Torques, Sealants and Grease Application

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Adhesive/Sealant Application		
←	Apply on Contact Surfaces	
· · · · · · · · · · · · · · · · · · ·	Apply on bolts threads /on pins	

Gasket Sealant			
Presence	Adhesive make and type	Technical characteristics	Strength
	Superbond 529	Flat surface sealing	High
	Superbond 519	Flat surface sealing	Low
0	Superbond 539	Uneven surface sealing	High
	Loctite Tight 5205	Even surface sealing with possibility	High
		of micro-moments	

Thread Parts Sealant			
Presence	Adhesive make and type	Technical Characteristics	Strength
	Superbond 321	Locking of Threaded Parts	Medium
	Superbond 331	Locking of Threaded Parts	High
0	Superbond 438	Locking of Threaded Parts	High, Special Appl.

Fixing Parts Sealant			
Presence	Adhesive make and type	Technical characteristics	Strength
0	Superbond instant 25	Fixing adhesive	Medium Bond
	Superbond 433	Fixing adhesive	Strong Bond
0	Superbond 321	Fixing adhesive	Medium Bond
0	Superbond SB14	Rubber Fixing adhesive	Strong Bond

Grease Application in Assembly			
$\mathbf{e}$	POLYMER 400	Apply on the Indicated Surfaces	
	MU/EP2	Fill/Apply in Excess	

4WD Mechanical Drop Box

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D-6
CLUTCH HOUSING

12x12 Synchro Shuttle



## **DETAILS** 12x12 Synchro Shuttle



Sec. C-C



Sec. E-E







INGR. INV. REVERSE GEAR





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Sec. F-F

D-8



## **GEAR BOX DETAILS**







## GD-TPO AND PTO ASSY (540-540E)







Det. J



Sec. B-B



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D-12











## INNER GEAR CONTROL ASSY

#### FOR ALL MODELS







Sec. W-W





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Sec. H-H

Sec. F-F





## SERVICE MANUAL

D-15

## OUTER GEAR CONTROL ASSY





Sec. X-X



LIQUID GASKET SILASTIC 732





Sec. K-K



## **D.2 POWER FLOWS**

FRW FIRST SPEED-HIGH FOR ALL MODELS



D-17

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## POWER FLOWS

FRW FIRST SPEED-MEDIUM FOR ALL MODELS

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D-18

J. POWER FLOWS FRW FIRST SPEED - LOW



D-19

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#### **POWER FLOWS**

FRW/REV TRANSMISSION POWER FLOW 12+12 SYNCRHO SHUTTLE



## D.3 ASSEMBLY TYPCIAL DATA

Position 1	End float
Gear Box	Min 0.20 Max 0.30 mm

Shims Range											
Thickness (mm)	Thickness (mm) 0.10 0.15 0.20 0.50										
Quantity											



Position 2	End float
Gear Box	Min 0.00 Max 0.00 mm

Shims Range										
Thickness (mm)							0.10	0.15	0.20	0.50
Quantity										



Position 3	End float
Gear Box	Min 0.15 Max 0.25 mm

Shims Range									
Thickness (mm)							0.05	0.10	0.30
Quantity									



Position 4	End float
Gear Box	Min 0.15 Max 0.25 mm

Shims Range										
Thickness (mm)								0.01	0.3	0.5
Quantity										



Position 5	End float
Gear Box	Min 0.0 Max 0.1 mm

Shims Range									
Thickness (mm) 0.10 0.30 0.50									
Quantity									



#### **D.4 Filling and Checks**

Warning: To drain and load the oil and to check the oil level the transmission must be horizontal.

#### Scheduled maintenance oil drain

To drain the oil remove the level plug (1) and the drain plug (2).

Danger: Risk of violent oil ejection, follow carefully all the safety procedures indicated in this manual and in the vehicle manual.

See: cap.B - SAFETY INSTRUCTIONS

Drain all oil. Clean the plug (2) and tighten it to the prescribed torque (sec.C.6).

#### Scheduled maintenance oil filling

Carry out the following instructions:

Fill the transmission with oil to the maximum level marked on the level dipstick (1). Apply the parking brake. Keep the speed control in NEUTRAL range. Start the engine by keeping the slow running of 800-1000 rpm until an oil temperature higher than 25 °C is obtained. Check that the transmission oil level is in the prescribed range on the level dipstick (1). If necessary, top up with oil to keep the level in the prescribed range.

#### Scheduled maintenance oil level check

Use the oil level dipstick (1) to check the oil level.

Warning: If leakage or any other factor determining fall in the oil level is found, then it is advisable to check immediately, in order to avoid damages to the mechanical parts.

POSITION	Descriptions (next figure)
1	Oil level dipstick(oil filling port)
1	Oil filling port
2	Oil drain port
3	Greaser
4	Brakes breather

FILLING AND CHECK POINTS

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D-27



## 12+12 MR SYNCHRO SHUTTLE 4WD MECHANICAL DROP BOX

#### **D.5 Service schedule**

Specified maintenance intervals are for standard-duty use. Severe operating conditions may require more short intervals.

Ten	npi previsti/Red	commended in	tervals	Operation
50 h	400 h	800 h	1200 h	
				Change the transmission/hydraulic oil
				Change the oil suction strainer
				Change high pressure filter element
				Grease trumpet bearings
				Check automatic pick-up hitch for
				correct operation

#### Lubricants application range

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D-29



# DISASSEMBLY AND ASSEMBLY OPERATIONS

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## D.1 4WD DROP BOX (MECHANICAL)

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90 Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90 Worlddtrac

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E-1

#### **D.1.1 Disassembly**

Some of the following pictures may not show exactly your machine, but the process is the same.





Remove the fastening screws (20). Remove the cover (19). Note: the cover is attached with sealant

Drain the oil completely from the transmission. Unscrew the bolts (23) and remove the group.

Tap on the shaft end to release the transmission group bearings. **Note:** it's advisable to use a soft hammer to do not damage the shaft.

FIG. 2



FIG. 3



FIG. 4

Remove the fastening screws (**13**). Disassemble the cover (**14**). **Note:** the cover is attached with sealant.

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E-2

Remove the seal ring (1) from the cover (14) by mean of a pad and a hammer.

Note: this is a destructive operation for the seal ring.



FIG. 5



FIG. 6



FIG. 7



FIG. 8

Push the shaft (3) by mean of a pad and a hammer to extract the bearing (2) from the housing.

Remove the shaft/bearing assy.

Remove the spacer (10) and the gear (11).

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E-3

Remove the clutch sleeve (9).

Remove the bearing (12).

Remove the snap ring (4) to disassemble the clutch sleeve.

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**Danger:** the washer (5) and spring (8) can be ejected with force Against the operator.



FIG. 9



FIG. 10



FIG. 11



FIG. 12

Remove the washer (5).

E-4

Remove the springs (8).



FIG. 13



FIG. 14



FIG. 15



FIG. 16

Remove the sleeve (7) from the clutch sleeve (9). Collect the springs (8)

Release the lock nut (27).

Remove the fastening screws (28).

**Danger:** the spring (**29**) can be ejected with force against the operator.

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Collect the spring (29) and ball (30).

Remove the plug (**32**). **Note:** the plug is attached with sealant.

Remove the pin (31).

Extract the shaft (33).

**Danger:** the ball (**34**) and spring (**35**) can be ejected with force against the operator.

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FIG. 17



FIG. 18



FIG. 19



FIG. 20

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E-6

Collect the ball (34) and spring (35).



FIG. 21



FIG. 22



Check the disassembled parts wear condition.

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FIG. 23



FIG. 24

Collect the fork (16).

Remove the pin (24).

E-7

Remove the lever (**26**) and the shaft (**17**). Remove the spring (**18**).



FIG. 25

Remove the seal ring (25). Note: this is a destructive operation for the seal ring.



FIG. 26

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E-9

#### D.1.2 Assembly

Some of the following pictures may not show exactly your machine, but the process

Clean with care the housing (**15**). Check the wear condition of the bearings seats.

Insert the seal ring (25) into the housing (15) with the special tool CA715619 and a hammer.

Lubricate the seal ring (**25**). **See:** sec. C.4 and sec E.1. (4WD mechanical drop box).

Respect indicated assembly position. **Note:** the springs (**35**) and (**29**) are not equal.

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FIG. 1



FIG. 2



FIG. 3



FIG. 4



FIG. 5



FIG. 6



FIG. 7

SERVICE MANUAL

Insert the special tool CA715620 into the housing (**15**). **See:** sec. C.4. and sec E.1. (4WD mechanical drop box).

Insert the spring (35) and ball (34) into the housing (15).

Push with a punch the ball (**34**) on the spring (**35**) then insert the special tool CA715620 on the ball (**34**).

Insert the fork shaft (33) in the housing (15) pushing forward the special tool CA715620.

Collect the special tool CA715620.

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E-9

Assemble the spring (18) to the clutch shaft (17).



FIG. 8



FIG. 9



FIG. 10



FIG. 11

Assemble the lever (26) to the shaft (17). Note: align the pin hole in the shaft (17) to the hole in the lever (26).

Lock the shaft (**17**) in the right position with a punch. Assemble the pin (**24**).

Assemble the fork (16) to the clutch shaft (17) in the housing (15).

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E-10

Insert the shaft (33) in the fork (16).

Note: align the pin hole in the shaft (33) to the hole in the fork (16).



FIG. 12



FIG. 13



FIG. 14



FIG. 15

Insert the bearing (12) into the transmission housing with the special tool CA715622 and a hammer.

See: sec. E.1. (4WD mechanical drop box).

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SERVICE MANUAL

Insert the fastening pin (31) with a punch and a hammer.

Apply prescribed sealant on the plug thread (**32**). Assemble the plug (**32**) and tighten it to the prescribed torque. **See:** sec. C.4.


FIG. 16



FIG. 17



FIG. 18



FIG. 19

Insert springs (8) into the sleeve (7), to assemble the clutch Sleeve group.

Assemble the sleeve (7) to the clutch sleeve (9). **Note:** check the springs (8) and key (6) position.

Assemble the washer (5).

Assemble the snap ring (4).

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E-12

Remove the clutch sleeve (9) to the fork (16).



FIG. 20



FIG. 21



FIG. 22



FIG. 23

Assemble the bearing (2) onto the shaft (3) with the special tool CA715623 and a hammer.

See: sec. E.1. (4WD mechanical drop box).

Insert the spacer (10) and gear (11) in the housing. Assemble the shaft (3) with bearing (2) as shown.

Insert the bearing (2) and shaft (3) into the housing (15) with the special tool CA715623 and a hammer.

See: sec. E.1. (4WD mechanical drop box).

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E-13

Apply prescribed sealant on the screw thread (28). Adjust the screw (28) position to have 35 Nm of clutch torque value(M) on the lever axis.

Assemble the nut (27) and tighten it to the prescribed torque. See: sec. C.4.



FIG. 24



FIG. 25



FIG. 26

Apply prescribed sealant on the covers (14) and (19) on the housing/cover contact surface.

Insert the seal ring (1) into the cover (14) with the special tool CA715621 and a

See: sec. C.4 and sec. E.1 (4WD mechanical drop box).

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See: sec. C.4.

hammer.

Lubricate the seal ring (1).



FIG. 27

E-14

SERVICE MANUAL

Clean with care the covers (14) and (19).

Assemble the covers (14) and (19) to the housing (15) with Fastening screws (13) and (20).

Tighten the fastening screws to the prescribed torque. **See:** sec. C.4.

Apply prescribed sealant on the housing contact surface.

Assemble the housing to the vehicle transmission group with bolts (23). Tighten the bolts to the prescribed torque.

Fill the vehicle transmission group with specified oil. **See:** sec.C.4, C.7 and C.8.



FIG. 28



FIG. 29



FIG. 30

Observe indicated 2WD/4WD clutch parameters.

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# D. 2 FINAL DRIVE



		For Models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90 Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical	75 & 90
	control brake	Worldtrac

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#### **D.2.1 Disassembly**

- 1. Unscrew locking screws (7) of trumpet (6).
- 2. Remove trumpet (6) from gear box.
- 3. Remove shaft (20) from the transmission.
- 4. Remove bolt stop (16).
- 5. Unscrew screw (15).
- 6. Remove thrust washer (14) and shims (13).
- 7. Extract planetary carrier (12).
- 8. Remove locking screws (17) and disassemble

planetary carrier.

9. Remove from each shaft: thrust washer (25), bearing

(23), gear (22) and bearing (21).

- 10. Remove pins (8) from trumpet (6).
- 11. Remove O-Ring (19) on ring gear (18).

Note: destructive operation for O-Ring.

- 12. Remove snap ring (11).
- **13.** Collect bearing cone (**10**).
- **14.** Turn the group upside down.
- 15. Extract the wheel shaft (1) from trumpet (6).
- 16. If necessary remove studs (2) from wheel axle (1).
- 17. Remove seal ring (3) from trumpet (6).

Note: Destructive operation for seal ring.

- **18.** Remove bearing cone (4).
- **19.** Extract bearing cup (**4**) from trumpet (**6**).
- 20. Turn trumpet (6) upside down.
- **21.** Remove bearing cup (**9**) from trumpet (6).
- 22. Extract seal ring (9) from trumpet (6).
- Note: destructive operation for seal ring.
- 23. If necessary remove greaser (5) from trumpet (6).

#### D.2.2 Assembly

1. With vertical trumpet:

Fill with grease as shown in the figure using tool

CA715844. Assemble bearing cup (4).

See: fig.1, sec. C.4 and sec. E.1 (Final drive).

 $\textbf{2.} \text{Assemble bearing cone} \ \textbf{(4)}. \text{Fill with grease again}.$ 

See: fig.1.

3. Assemble seal ring (3) with tool CA715836.

See: fig.1 and sec. E.1 (Final drive).

4. Assemble studs (2) on wheel axle (1).

5. Warm the outlined area at 120 °C for 4/5 minutes to

allow introduction of the wheel axle (1).

See: fig.1



6. Assemble wheel axle (1).

7. Turn trumpet holding axle beam.

8. Assemble seal ring (9) with tool CA715826.

See: sec. E.1 (Final drive).

 $\boldsymbol{9.}$  Assemble bearing cup  $(\boldsymbol{10})$  with tool CA715827.

See: sec E.1 (Final drive).

**10.** Assemble bearing cone (**10**).

11. Assemble snap ring (11).

12. Assemble a new O-Ring (19) on ring gear (18).

13. Assemble pins (8) on trumpet (6).

## 14. Assemble planetary gear assy.

- Assemble on gear (22) bearing cups (21) and (23) using tool CA715827.

- Assemble bearing cone (21) on planetary gears

carrier (12) pin. Assemble gear (22) to gear carrier (12).

- Assemble bearing cone (23).

- Assemble pin (24).
- Assemble washer (25).

- Apply sealant to screw (17).

See: sec. C.4.

- Tighten screw (17) to requested torque.

See: sec. C.4.

- Assemble planetary gear assy on trumpet.

See: fig.2 and sec. E.1 (Final drive).



Fig.2

E-19

#### D.2.3 Taper roller bearings preload

**1.** If parts as trumpet or wheel axle are not replaced, use shims collected during disassembly. Check correct preload.

2. If trumpet or wheel axle are to be replaced, proceed

as follows:

- start with a packet of shim (13) 1 mm each;

- assemble washer (14) and screw (15);

- tighten screw (15) to prescribed torque.

See: fig.3 and sec. C.4.









3. Measure preload P of the taper roller bearings with a dynamometer whose cord is wound on the wheel axle (1).The real preload P is measured on D= 245 mm and it must be within following range:

P= 13-20 N

If P < (13-20) N, remove shims.

If P > (13-20) N, add shims, choose them from the range available, so as to observe prescribed preload.

See: fig.4, 5 and 6.







T	Т	L	E-20	SERVICE MANUAL

4. Assemble bolt stop (16).

5. Insert shaft (20) into the transmission.

See: fig.8.



Fig.7



Fig.8

6. Assemble trumpet (6) to gear box.

See: fig.9.



Fig.9

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7. Assemble locking screw (7) to the requested torque.

See: sec. C.4.

8. Assemble greaser (5) and tighten to the prescribed torque.

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See: sec. C.4.

# D.3 Upper Covers and Rockshaft

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

## **D.3.1 Disassembly**

1. Remove oil dipstick.

Hook rockshaft to a suitable lifting device.

Remove rockshaft case (9) after unscrewing screws (8).

Warning: approximate weight of rockshaft case assembly is 82 Kg.

See: fig.1.

2. Remove Shield

Warning: during disassembly procedure do not damage the shield.

Note: for rockshaft disassembly see tractor manual.

See: fig.2







Fig.2

- **3.** Unscrew fastening screws (**4**).
- 4. Remove gear box lever assy (3).
- 5. Unscrew fastening screws (6).
- 6. Remove cover (7).

See: fig.3.



Fig.3

SERVICE MANUAL

## D.3.2 Assembly

**1.** Clean all contact surfaces of cover (**7**) with care.

2. Apply prescribed sealing.

See: sec. C.4.

3. Assemble cover (7) to the gear box (1).

See: fig.3.

# 4.

Note: cover (7) correct assembly.

See: fig.4.



Fig.4

**5.** Assemble screws (**6**) to the prescribed torque.

See: sec. C.4.

6. Clean all contact surfaces of the lever assy (3) with care.

7. Apply prescribed sealing.

See: sec. C.4.

8. Assemble lever assy (3) on gear box (1).

Note: check the correct assembly of centring pins (2) and gear clutch lever.

**9.** Assemble screws (**4**) to the requested torque.

See: sec. C.4.

E-24

10. Clean mating surfaces of rockshaft case and differential housing. Apply a coat of Loctite® 574 to mating surfaces.
See: fig.5.
11. Install rockshaft case (9) using a suitable lifting device.
Screw up the eight bolts (8). Torque wrench setting: 120
Nm (90 lb.ft).

**Warning:** during the assembly procedure do not damage the shield. **See:** fig.6.



Fig.1



Fig.2

# D.4 Outer gear controls



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

E-26

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#### **D.4.1 Disassembly**

- 1. Unscrew fastening screws (1).
- 2. Remove cover (2).
- 3. Loose rubber hose clamp (4) and remove rubber booth (3).
- 4. Remove washers (6) and snap rings (7) from the levers (11).
- 5. Remove locking screws (5).
- 6. Disassemble plate (8) from the lever support (12).
- 7. Remove O-Rings (10).
- 8. Remove lever (11).
- 9. If necessary extract pins (9) from the levers (11).
- 10. Turn cover upside down (15).
- 11. Remove pins (25).
- 12. Remove lever (27), spring (26), long lever (24) from the lever support (12).
- **13.** Remove pins (**21**).
- 14. Remove lever (23), spring (22) and short lever (20) from the lever support (12).
- 15. Remove screws (13).
- 16. Remove lever support (12) from the cover (15).

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#### **D.4.2 Assembly**

- **1.** Clean all processed surfaces with care.
- 2. Insert pins (19) into the lever support (12).
- 3. Apply prescribed sealing on the contact surfaces.

## See: sec. C.4.

- 4. Assemble lever support (12) to the cover (15).
- 5. Assemble locking screws (13) to the requested torque.

See: sec. C.4.

6. Lubricate rods housings.

See: sec. C.4.

7. Assemble short rod (20) into the lever support (12).



Fig.1



Fig.2

- 8. Assemble spring (22).
- 9. Assemble lever (23) at the cover side (15).
- 10. Assemble two pins (21).
- 11. Assemble long lever (24) into the lever support (12).
- 12. Assemble spring (26).
- **13.** Assemble lever (**27**) at the over side (**15**).
- 14. Assemble the pins (25).
- **15.** Turn cover (**15**) upside down.
- 16. Lubricate levers housings (11) on the lever support (12).

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See: sec. C.4.



E-29

17. Insert pins (9) on the respective levers (11).

18. Assemble levers (11) with clutch ball to the rods (20) and (24).

**19.** Check pins (9) be inserted in the respective housings on the lever support (12).

**20.** Lubricate two new O-Rings (**10**).

21. Assemble two O-Rings (10) in the circular plate (8).

22. Apply prescribed sealing on the contact surfaces of plate (8) and of lever support (12).

See: sec. C.4.

23. Assemble plate (8) to the lever support (12)



**24.** Assemble locking screws (**5**) to the requested torque. **See:** sec. C.4.

25. Assemble snap rings (7) to the levers (11).

**26.** Apply prescribed sealing on the cover support surface (**2**).

See: sec. C.4.

27. Assemble

**28.** Assemble locking screws (1) to the requested torque.

See: sec. C.4.

**29.** Insert washers (6) on the lever (11) above snap rings (7).

**30.** Assemble rubber booth (**3**) with hose clamp (**4**).

**31.** Apply prescribed sealing to the plug (**16**).

**32.** Assemble plug (**16**) using driver CA715846 and a hammer

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Fig.4

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# D.6 Clutch housing D.6a Synchro shuttle



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

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#### **D.6a.1 Disassembly**

- 1. Remove pins (12).
- 2. Remove lever (21).
- 3. Remove pins (15).
- 4. Remove lever (24).
- 5. Remove and disassemble following components:

clutch control forks (13) and (16) with relevant pins (14) and (17), disc pusher ring (1), bearing (2), sleeve pusher (3), bearing (4), sleeve (5) and sleeve (7).

- 6. If necessary remove bushes (22) from clutch housing (23).
- 7. Remove screws (9) and assembled group.
- 8. Disassemble following components: sleeves support (8) and bearing (10).
- 9. Remove screws (29), (30) and (31).

Danger: lock clutch housing (23) using an appropriate lifting apparatus.

**10.** Remove clutch housing (**23**) from gear box.

#### D.6a.2 Assembly

1. Assemble bearing (10) to sleeves support (8) using special tool CA716139.

See: sec. E.1 (Clutch housing - syncro shuttle).

2. Assemble sleeves support (8) to clutch housing (23) tightening screws (9) to prescribed tool. Grease surfaces of sleeves support (8).

See: sec. C.4.

3. Apply prescribed sealant to clutch housing (23) surfaces.

See: sec. C.4 and fig.1.

- **4.** Assemble clutch housing (**23**) to gear box.
- 5. Assemble screws (29), (30) and (31) and tighten them to prescribed torque.

See: sec. C.4.

6. Assemble bushes (22) into clutch housing (23) with special tool CA716138. Grease bushes (22).

See: sec. E.1 (Clutch housing - syncro shuttle) and sec. C.4.

- 7. Assemble bearing (4) to sleeve pusher (3) using prescribed tool.See: sec. E.1 (Clutch housing syncro shuttle).
- 8. Assemble sleeve (5) to sleeve pusher (3).
- 9. Grease sleeve (7) surfaces.

See: See: sec. C.4.

10. Insert sleeves (3) and (5) just assembled into sleeve (7).

**11.** Assemble bearing (**2**) into disc pusher (**1**) with special tool CA716143.

See: sec. E.1 (Clutch housing - syncro shuttle).

**12.** Assemble disc pusher (1) onto sleeve (7) with special tool CA715021.

See: sec. E.1 (Clutch housing - syncro shuttle).

E-31

- 13.Assemble assy to sleeves support (8).
- 14.Assemble pins (17) and (14) to forks (16) and (13).See: fig.2.
- 15. Assemble fork (16) to assy and assemble lever (24).
- 16. Assemble pins (15).
- 17. Assemble fork (13) to assy and assemble lever (21).
- 18. Assemble pins (12).







Fig.2







		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

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# **D.8.1 Disassembly**

- 1. Remove PTO hood (27) from cover (24).
- 2. Remove screws (25) from cover (24).
- 3. Remove cover (24) from gear box.
- 4. Assemble cover (24) on the vice.
- Remove seal ring (26) from cover (24).
   Note: destructive operation for seal ring.
- 6. Remove bearing (23) from cover (24).
- 7. Extract PTO shaft (12).
- 8. Remove bearing (13) from shaft (12).
- **9.** Remove pin (**2**).
- 10. Remove lever (9).
- 11. Remove pin (5).
- 12. Remove PTO control fork (7) after raising PTO control lever (1).
- 13. Remove ball (3) and spring (4) from fork (7).
- 14. Extract PTO control lever (1).
- 15. Remove seal ring (8).

Note: destructive operation for seal ring.

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- 16. Remove PTO control pin (6).
- 17. Extract spacer (22) and washer (21).
- 18. Remove gear (20).
- 19. Remove PTO output shaft assy (A), made of PTO sleeve (19), PTO output shaft (18), gear (17) and washer (16).
- 20. Remove bearings (11) and (15) and supports (10) and (14) with prescribed tool.

## **D.8.2 Assembly**

1. Assemble support (14) with tool CA716110.

See: sec. E.1 (PTO power take off).

2. Assemble outer ring of bearing (11) into support (10) with tool CA716111.

See: sec. E.1 (PTO power take off).

3. Assemble bearing (15) into support (14) with tool CA716108.

See: sec. E.1 (PTO power take off).

4. Insert PTO control pin (6) into its seat.

5. Assemble gear (17) onto PTO output shaft (18).

See: fig.1.

6. Assemble washer (16).

See: fig.2.



Fig.1



Fig.2

7. Assemble PTO output shaft (18) onto bearing (15) using a driver and a hammer and insert PTO sleeve (19).See: fig.3 and 4.











E-35

8. Insert gear (20).

See: fig.5.

9. Insert washer (21) and spacer (22).
10. Assemble spring (4) and ball (3) into PTO control fork (7) and assemble PTO control fork (7) into the pin (6).
11. Engage the fork (7) into the PTO sleeve (19).
See: fig.6.



Fig.5

12. Assemble a new seal ring (8) using tool CA715809.
Grease the seal ring (8).
See: sec. C.4 and E.1 (PTO power take off) and fig.7.
13. Assemble PTO control lever (1).
See: fig.8

See: fig.8



Fig.7



Fig.6



E-36

14. Assemble lever (1) to pin (6) and set pin (6) using a driver and a pad.

See: fig.9 and 10.



Fig.9

15. Assemble pin (5).

See: fig.11.

16. Assemble lever (9).

17. Assemble pin (2).

18. Assemble bearing (13) and inner ring of bearing

(11) onto PTO shaft (12) using a pad.

**19.** Insert PTO shaft (**12**) using a driver and a hammer.

See: fig.12.



Fig.11

20. Assemble bearing (23) onto the cover (24) using tool CA716211.

See: sec. E.1 (PTO power take off).

**21.** Turn the cover (**24**) and assemble a new seal ring (**26**) using tool CA716107.

See: sec. E.1 (PTO power take off).

22. Grease the seal ring (26).

See: See: sec. C.



Fig.10



Fig.12

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**23.** Apply prescribed sealant onto gear box surfaces.

See: sec. C.4.

24. Assemble cover (24) onto gear box.

See: fig.13.

**25.** Assemble and tighten screws (**25**) to prescribed torque.

See: fig. 14 and sec. C.4.



Fig.13



Fig.14

26. Assemble PTO hood (27).

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# **D.9 PTO selection control**



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

SERVICE MANUAL

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#### **D.9.1 Disassembly**

- 1. Remove pin (1).
- 2. Remove PTO control lever (10).
- 3. Remove spring (8) and ball (7).
- 4. Remove screw (9) and PTO selection plate (6).
- 5. Collect sliding block (3), slightly pulling out PTO coupling sleeve (5).
- 6. Extract pin (2).
- 7. Remove O-ring (4) from pin (2).

## **D.9.2 Assembly**

- 1. Assemble a new O-ring (4) and sliding block (3) on pin (2).
- 2. Grease O-ring (4).
- 3. Move clutch fork using a lever and pull out PTO coupling sleeve (5).
- 4. Insert pin (2) in its seat on gear box.
- 5. Insert sliding block (3) on PTO coupling sleeve (5).
- 6. Reinsert PTO coupling sleeve (5).
- 7. Assemble PTO selection plate (6).
- Tighten screw (9) to prescribed torque.
   See: sec. C.4 and fig.1.
- Grease hole shown in figure and position ball (7).
   See: fig.1.
- 10. Insert spring (8) into PTO control lever (10).
- 11. Assemble PTO control lever (10).

Note: check spring and ball position.

12. Assemble pin (1).

See: fig. 2



Fig.1





E-42





**14.** PTO operation: by shifting lever in the shown direction (25° from neutral position N) you switch over independent PTO operation; by shifting lever in the shown direction (15° from neutral position N) you switch over GD PTO operation.

See: fig.4.



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# D.10 PTO shaft group



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

E-44

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## **D.10.1 Disassembly**

- 1. Remove PTO shaft (11). See: sec. D.8.
- 2. Remove PTO selection control pin (12). See: sec. D.9
- **3.** Slide out PTO shaft (1).
- 4. Remove pin (10).
- 5. Extract PTO coupling (9).
- 6. Extract PTO coupling sleeve assy (2,3,4,5,6,7,8).
- 7. Remove washer (2).
- 8. Remove safety ring (4), after acting on snap ring (3).
- 9. Remove springs (7) and balls (8).
- 10. Remove snap ring (3).
- **11.** Remove PTO brake ring (5).



Fig.1



Fig.2



- Assemble snap ring (3) on PTO coupling sleeve (6).
   See: fig.1.
- Insert PTO brake ring (5) inside PTO coupling sleeve (6).
   See: fig.2.
- Insert balls (8) in apposite holes on PTO coupling sleeve (6).
   See: fig.3.
- Insert springs (7) on balls (8).
   See: fig.4.

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Fig.3





SERVICE MANUAL

- Insert safety ring (4), by acting on snap ring (3).
   See: fig.5.
- 6. Push springs (7) in their seat with a screwdriver. **See:** fig.6
- 7. Check the snap ring (3) is in its seat.
- 8. Insert washer (2) on PTO shaft (1).
- Insert PTO coupling sleeve assy (3,4,5,6,7,8) on PTO shaft (1).
   See: fig.7.
- **10.** Insert PTO coupling (9) on PTO shaft (1).
- **11.** Assemble pin (**10**). **See:** fig.8.
- **12.** Check pin is inside on both sides.
- **13.** Push PTO shaft (1) with PTO coupling (9) inside PTO coupling sleeve (6).
- 14. Assemble PTO selection control pin (12). See: sec. D.9.

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15. Assemble PTO shaft (11). See: sec. D.8.



Fig.5



Fig.6



Fig.7



Fig.8

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E-47
### D.11.2 Actuator assembly

Assemble gasket (12) on piston (13).



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Assemble spacer (9).



Fig.1



Fig.2



Fig.3

Assemble snap ring  $(\mathbf{8})$  and piston assy on the brake support



Fig.4



Fig.5



Fig.6



Fig.7

Assemble spring screen (7).

Assemble spring (6) and bush (5).

Assemble cover (4).

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E-49



# D. 11.3 View details of Brake housing inside Parts

No.	DESCRIPTION	Qty.
1	PIN D.11	2
2	PIN LOCKING SPRING	2
3	TIE BAR	2
4	BRAKE MECHANISM	2
5	BRAKE DISC	10
6	BRAKE COUNTER-PLATE	6
7	FLANGE	2
8	BOLT	4

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No.	DESCRIPTION	Qty.
9	TIE ROD	4
10	SPRING	6
11	BALL	10
12	NUT	4
13	BOLT M12X10	10
14	BRAKES FLANGE	2
15	PIN D.12X50	4

# D 9.11 View Details of Brake Paddles Parts



No.	Reference	DESCRIPTION	Qty.
1	30014116AA	RUBBER PAD	3
2	10010439AC	BRAKE PEDAL ASSY (RIGHT)	1
3	10080077AA	ADJUSTABLE TIE ROAD (FOR BRAKE PEDAL)	2
4	20002549AA	CIRCLIP 25*1.2N.I:S3075 (PART-1)	2
5	10006738AB	WASHER (BRAKE PEDAL)	2
6	10010523AB	TENSION SPRING (BRAKE ASSY.)	2
7	10004498AA	FELT RING	3
8	0431030036	SEALING WASHER DIA 30*36*2	3
9	04020200030	EXTERNAL CIRCLIP	3
10	10005187AA	LINK PIN	8
11	10080078AB	ADJUSTABLE TIE ROAD	2
12	10080874AA	LINK PIN	2

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No.	Reference	DESCRIPTION	Qty.
13	04030800012	MICD WASHER DIA 13*25 DIA 24*2.5	2
14	0403040008	SPRING WASHER	1
15	10080071AC	BRAKE PEDAL SHAFT (ASSY.)	1
16	04040708065	HEX BOLT M8*1.25*65	1
17	04030800010	M/CD WASHER DIA 10.5*DIA 21*2	8
18	04010102025	SPLIT PIN DIA 2*25	10
19	10080079AA	ADUSTABLE TIE ROAD FOR CLUTCH PEDAL	1
20	10010437AE	CLUTCH PEDAL ASSY.	1
21	10010438AD	BRAKE PEDAL ASSY (LEFT)	1
22	10010524AB	TENSION SPRING (CLUTCH ASSY)	1
23	10080072AC	LUG ASSEMBLY (LEFT)	1
24	10080073AC	LUG ASSEMBLY (RIGHT)	1

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# D 9.12 View Details of Hand Brake Linkage Assembly

No.	DESCRIPTION	Qty.
1	HANDBRAKE LEVER RH	1
2	ELASTIC RINGH D.8	2
3	BRAKE ROD	2
4	BRAKE ROD PIN D 10X28	2
5	NUT	2
6	BRAKE ROD PIN D.12.5X31	2
7	HANDBRAKE NUT	2

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No.	DESCRIPTION	Qty.
8	8 ELASTIC RINGH D.9	
9	9 HANDBRAKE LEVER RH	
10	PIN 10X45	2
11	HANDBRAKE LEVER LH	1
12	HANDBRAKE LEVER LH	1
13	HANDBRAKE LEVER	2

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# D.12 Parking brake



		For Models
Т3	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T4	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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### D.12.1 Disassembly

Some of the following pictures may not show exactly your product transmission, but the indicated operations are correct anyway.

Remove levers and tie-rods of parking brake.





Remove pin (1).

Remove lever (2).

Slide out rod (3).

Remove seal (4).

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Fig.2



Fig.3



Fig.4



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Remove pin (5).

Slide out lever (6). Remove slave cylinder. See: sec. D.11.

Unscrew fastening screws of final drive.

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Balance transmission.



Fig.6



Fig.7



Fig.8



Fig.9

E-57

### Secure with a rope the final drive.

Pry off to table out the final drive.

Remove split pin (7).

Remove pin (8) by means of a magnet.

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Fig.10



Fig.11



Fig.12



Fig.13

E-58

Slide out final drive axle beam.



Fig.14



Fig.15



Fig.16



Fig.17

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Unscrew fastening screws of differential brake block.

Use two of screws just assembled to remove brake assy.

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E-59

Remove brake assy.

### Remove screw (9) locking brake lever (10).

Remove levers assy

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9

Fig.18



Fig.19



Fig.20

## Remove O-Ring (11) from brakes control pin (12).

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### D.12.2 Assembly

Some of the following pictures may not show exactly your transmission, but the indicated operations are correct anyway

Assemble O-Ring (11) and insert brakes control pin (12).

Assemble levers assy.

Tighten screw (9) locking brake lever.

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Fig.1



Fig.2



Fig.3

Insert brake assy.



Fig.4



Fig.5







Fig.7

Tighten two fastening screws of differential brake block to the requested. See: sec. C.4.6

Once brake has been placed to stroke end, check that brake discs are released.

Insert pin (8) on the brake levers.

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Insert sun drive shaft.



Fig.8



Fig.9



Fig.10



## Fig.11

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Insert split pin (7) with open side in proper seat.

Assemble final drive.

Tighten fastening screws of final drive to the requested torque. See: sec. C.4.

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### Insert seals (4) with suitable tool.

# Insert rod (3).

Assemble brake tie rod lever (2).

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Assemble pin (1).



Fig.12



Fig.13



Fig.14



Fig.15

E-64

Assemble slave cylinder. Insert brake pin lever (6). See: sec. D.11

Fig.16



Fig.17

Insert spring pin (5).

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E-65

# D.13 Housing sensors assy

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		Engine neutral
		start switch(1)
T1	12+12 MR synchro shuttle 2WD mechanical control brake	Standard
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	Standard

E-66

### D.13.1 Disassembly

Some of the following pictures may not show exactly your product transmission, but the indicated operations are correct anyway.

Remove engine neutral start switch from the box.

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Fig.1

Remove and check condition of all engine neutral start switch components.



Fig.2

### D.13.2 Assembly

Some of the following pictures may not show exactly your product transmission, but the indicated operations are correct anyway.



Fig.1

Assemble engine neutral start switch (1)



Fig.2



Fig.3

Assemble engine neutral start on the transmission box.

Note: "Engine neutral start switch technical features.

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# D.14 Differential locking control

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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### **D.14.1 Disassembly**

- Remove rockshaft. Remove nut (7) and dowel (8). 1.
- 2. Do not remove plug (6).
- Remove pin (3). 3.
- Pull out pin (2) and remove spring (5). 4.
- Remove fork (4) from differential housing sleeve. 5.
- Remove O-Ring (1) from pin (2). 6.

### D.14.2 Assembly

- 1. Assemble plug (6) with prescribed sealant (only for first assembly). See: sec. C.4.
- 2. Assemble dowel (8) and nut (7) on plug (6). See: fig.1.
- Assemble O-Ring (1) on pin (2). 3.
- Assemble fork (4) on differential housing sleeve. 4. See: fig.2.



Fig.1

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Fig.2



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- Position spring (5) on fork (4) and insert pin (2).
   See: fig.3.
- Assemble pin (2) up to stroke end and assemble pin (3).
   See: fig.4.



Fig.3

- Assemble pin on gear box.
   See: fig.5.
- Apply sealant on dowel (8).
   See: sec. C.4 and fig.6.



Fig.5

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Fig.4



Fig.6

**9.** Adjust clutch position of fork as follows:

- with a screwdriver pry off pin. Shift pin (2) to the left and check with a thickness gauge the correct dimension of figure. **See:** fig.7, 8 and 9.











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- if end float turns out bigger than 0.5 mm dowel (8) has to be unscrewed.

- if end float turns out smaller than 0.5 mm dowel (8) has to be tightened. See: fig.10.

fasten nut (7) by keeping the dowel (8) locked.
See: fig.11.



Fig.10

- recheck end float.

See: fig.12.

Complete assembly with of the indicated components.
 See: fig.13.



Fig.11



Fig.12

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**11.** Assemble rockshaft.



Fig.13

12.

Note: stroke of fork (4).

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See: fig.14



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## D.15 Inner controls assy



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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#### **D.15.1 Disassembly**

- 1. Remove screw (40) and washer (41).
- 2. Remove screw (39), washer (38), spring (37) and ball (36).
- **3.** Remove split pin (**34**).
- 4. Remove plug (32). Remove pin (35) from fork (42).
- 5. Remove block (33) from pin (35).
- 6. Remove lock pin (50) with the help of a magnet.
- 7. Remove plug (54).
- 8. Remove spli pin (52).
- 9. Remove screw (43) and washer (44).
- 10. Remove screw (46), washer (47), spring (48) and ball (49).
- **11.** Remove screw (1) and washer (2).
- **12.** Remove split pin (**10**).
- 13. Remove screw (7), washer (6), spring (5) and ball (4).
- 14. Remove plug (57).
- 15. Remove pin (8) from fork (3).
- 16. Remove block (9) from pin (8).
- 17. Remove plug (56).
- 18. Remove lock pin (17) with the help of a magnet.
- 19. Remove screw (11) and washer (12).
- 20. Remove screw (61), washer (60), spring (59) and ball (58).
- 21. Remove split pin (14).
- 22. Remove split pin (16) from fork (13).
- 23. Remove plug (55).
- 24. Remove screw (26) and washer (27).
- 25. Remove screw (22), washer (23), spring (24) and ball (25).
- 26. Remove parts (18), (19), (20) e (21).
- 27. Remove fork (29).
- 28. Remove pin (51) and block (53).
- 29. Remove fork (45).
- 30. Remove idle gear.
- 31. Remove input shaft.
- 32. Remove front cover. Remove plugs (30) and (31).
- 33. Remove block (15) from pin (16).
- 34. Remove pins (16) and (28).
- 35. Remove primary shaft.
- 36. Remove forks (3) and (13).

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### D.15.2 Assembly

1. Assemble forks (3) and (13). See: fig.1.



**2.** Assemble primary shaft (**b**).

See: fig.2.

**3.** Before cover assembly, slide through the two holes shown in the figure pins (**28**) and (**16**). **See:** fig.3.



Fig.2

4. Assemble block (15) in the pin (16).See: fig.4 e 5.



Fig.3



Fig.4

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Fig.5

#### 5.

Note: after cover assembly pins (16) and (28) cannot slide though. See: fig.6.

6. Assemble plugs (30) and (31) using tool CA715801.

See: fig.7 and sec. E.1 (Gear box).



Fig.6

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Fig.7

7. Complete assembly of speed gears-primary shaft and input shaft.See: fig.8 and 9 e sec. D.20 and D.18



Fig.8

Assemble idle gear.
 See: fig.10 and sec. D.16.





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Fig.9



Assemble fork (45) (high-medium speed range synchronizer).
 See: fig.11.



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**10.** Assemble pin (**51**) and block (**53**).

See: fig.12.

**11.** Assemble range gears (primary shaft).**See:** fig.13 and sec. D.17.



Fig.12

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Fig.13

12. Assemble FRW-REV fork (29).

See: fig.14.

13. Assemble washer (27) and screw (26) on fork (29).

See: fig.15.



Fig.14



Fig.15

14. Assemble in the following order: ball (25), spring (24), washer (23) and screw (22).See: fig.16 and 17.





Fig.17

Fig.16

- **15.** Centre fork (**29**) in neutral position.
- **16.** Tighten screw (**26**) to the requested torque.

### See: sec. C.4.

Assemble plug (55). Assemble parts (18), (19), (20) and (21).

17. Verify that shuttle lever moves freely.

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Fig.18

**18.** Assemble pin (**16**) to fork (**13**).

See: fig.18.

- 19. Assemble washer (12) and screw (11) on the fork (13).
- 20. Insert pin (14) in the block (15).
- 21. Assemble in the following order: ball (58), spring (59), washer (60) and screw (61).See: fig.19



Fig.20

- 22. Centre fork (13) in neutral position.
- 23. Tighten screw (11) to the requested torque.See: fig.20 and sec. C.4.

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- 24. Verify that 3rd/4th speed control lever moves freely.
- 25. Insert lock pin (17).

See: fig.21.

26. Assemble plug (56).



Fig.21



27. Insert pin (8) into block (9).

See: fig.22.

- 28. Assemble pin (8) in the fork (3).
- 29. Assemble washer (2) and screw (1) in the fork (3).
- 30. Assemble in the following order: ball (4), spring (5), washer (6) and screw (7).

#### See: fig.23





- 31. Insert pin (10).
- 32. Centre fork (3) in neutral position.
- **33.** Tighten screw (1) to the requested torque. **See:** sec. C.4.
- 34. Check that 1st/2nd speeds control lever moves freely.
- **35.** Assemble plug (**57**). Assemble pin (**51**) and fork (**45**). **See:** fig.24.
- 36. Assemble washer (44) and screw (43) to the fork (45).
- 37. Assemble in the following order: ball (49), spring (48), washer (47) and screw (46).See: fig.25.







Fig.23



Fig.25
- **38.** Centre fork (**45**) in neutral position.
- **39.** Tighten screw (**43**) to the requested torque.**See:** fig.26 and sec. C.4.
- 40. Insert split pin (52) into the block (53).
- 41. Check that the middle/high speeds control lever moves freely.
- 42. Assemble plug (54).
- 43. Insert lock pin (50)

See: fig.27 and 28.



Fig.26



Fig.27



Fig.28

44. Assemble pin (35) and block (33).

45. Position fork (42) and block (33).

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46. Assemble pin (35) on the fork (42).

See: fig.29.

- 47. Assemble washer (41) and screw (40) on the fork (42).
- 48. Insert split pin (35).
- 49. Assemble in the following order: ball (36), spring (37), washer (38) and screw (39).

See: fig.30.







Fig.30

**50.** Tighten screw (**39**) to the requested torque.

See: sec. C.4.

- 51. Centre fork (42) in neutral position.
- 52. Tighten screw (40) to the requested torque.See: fig.31 and sec. C.4



Fig.31

- 53. Check that low speeds control lever moves freely.
- 54. Assemble plug (32).

55.

**Note:** blocks displacement on transmission. **See:** fig.32.

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Fig.32

# D.16 Idle gear



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		World Trac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		World Trac

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#### **D.16.1 Disassembly**

Note: To disassembly the idle gear the primary shaft does not need to be disassembled.

1. Remove split pin (6) from bush (5).

See: fig.2

- 2. Remove screw (7) and washer (8).
- 3. Collect gear (4) and bush (5) from the gear box (9).
- 4. Remove shaft (2) from the gear box (9).
- 5. Remove needle bearing (3) and O-Ring (1) from the shaft (2).

#### D.16.2 Assembly

Note: to assembly idle gear primary shaft does not need to be disassembled.

- 1. Lubricate new O-Ring (1) and assemble on the shaft (2).
- 2. Assemble needle bearing (3) on the shaft (2).
- 3. Position gear (4) and bush (6) in the inside of the gear box (9).
- 4. Assemble shaft (2) to the gear box (9).

See: fig.1.

- Assemble washer (8) and screw (7). Tighten screw to the requested torque.
   See: sec. C.4.
- Assemble split pin (6) on the bush (5) with prescribed special tool.
   See: fig.2.
- 7. Check gear rotation be free.



Fig.1



Fig.2

# D.17 Range gears (primary shaft)

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 70
		World Trac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 70
		World Trac

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### **D.17.1 Disassembly**

- Disassemble snap ring (1) from the gear box.
   See: fig.1.
- 2. Remove shims (2).

See: fig.2.







Fig.2

- Extract bearing (3) and shaft (15).
   See: fig.3.
- 4.

**Important:** When removing shaft assy (15) mark with a reference shaft levelling, otherwise, with a commercial tool (for hammering), shaft cannot be removed.

See: fig.3 and 4.



Fig.3

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Fig.4



5. Disassemble from shaft (15) in the gear box from the differential side in the following order: needles bearing (6), spacer (5), needles bearing (4), spacer (12), needles bearing (13) and spacer (14).

See: fig.5.



Fig.5

- 6. Remove gear (11) with washer (9) and gear (8) with sleeve (7) from the gear box.
- 7. Remove bearing (10) from the gear box.

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#### D.17.2 Assembly

- 1. Assemble bearing (10). See: fig.6.
- 2. Grease washer (9) and assemble it on gear (11).
- 3. Assemble sleeve (7) on gear (8).

Note: sleeve correct assembly.

See: fig.7.









4. Assemble in the shaft (15): spacer (14), roller bearing (13), spacer (12), roller bearing (4), spacer (5) and roller bearing (6). See: fig.8.

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5. Assemble in the gear box the gears (11) and (8) assembled.

See: fig.9.



Fig.8

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Fig.9

6. Insert shaft (15) with levelling downward assembled on gears (11) and (8).

Settle shaft (15) using a soft hammer up to stroke end.
 See: fig.10 and 11.





Fig.11

Fig.10

8. Assemble bearing (3) using the tools CA715821 and CA715830.
See: fig.12 and 13 and sec. E.1 (Gear box).
Alternatively you can use a punch paying attention not to damage the bearing (3).

See: fig.14.





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Fig.13



Fig.14

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- **9.** Assemble snap ring (**1**).
- Proceed as follows to determine end float [4]: measure value (B) with a thickness gauge, that is end float between bearing (3) and snap ring (1). Remove snap ring (1). Lubricate and assemble shim (2). Reassemble snap ring (1). Check again value (B) and repeat operations described previously so as to obtain end float value included in the prescribed range: 0.15-0.25 mm.

See: sec. C.6 and fig.15, 16.





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Fig.16

**11.** Check that gears rotate freely.

# D.18 Input shaft



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

SERVICE MANUAL

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#### **D.18.1 Disassembly**

- Remove four screws (9) of input shaft cover (11) and remove cover (11) from gear box.
   See: fig.1.
- 2. With the help of a screwdriver and using tool CA716202, detach input shaft from synchro shuttle. **See:** fig.2 and sec. E.1 (Clutch housing syncro shuttle).



Fig.1

**3.** Extract input shaft from gear box.

See: fig.3.

- 4. Position on work bench assembled input shaft.
- 5. Remove bush (2) If necessary (only for 24+24 models).
- Remove seal ring (14) If necessary (only for 12+12 models).
   Note: Destructive operation for seal ring.
- 7. Remove bearing (12) With a commercial puller.
- **8.** Remove shim (**8**).
- 9. Remove seal ring (10) and O-Ring (13) from cover (11) (only for 12+12 models).Note: Destructive operation for seal ring.
- **10.** Use a commercial puller to remove assy (**15**).

See: fig.4.







Fig.4

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Fig.2

**11.** Slide out assy (**15**) and shim (**3**).

See: fig.5.

12. Use a support for gear (6). Remove bearing (7).See: fig.6.



Fig.5

13. Collect shims (5).

See: fig.7.

14. Remove bearing (4).

See: fig.8.



Fig.7

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Fig.6



Fig.8

### D.18.2 Assembly

2.

1. Assemble bearing (4) on gear (6). See: fig.9.

Determine end float [5] or [5a]. See: sec. C.6. Measure dimension (A) with a gauge. Example A= 11.8 mm See: fig.10.





Fig.10

- Measure dimension (B) on bearing (7) with a gauge.
   Example B= 11 mm
   See: fig.11.
- 4. Determine shim (5) with dimension (S) to insert between bearings (4) and (7). S = (A-B)+(0 to 0.1)= 0.8+(0 to 0.1) mm

**See:** fig.12.



Fig.11

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Fig.12

#### 5. Select shims within shims range available.

SHIMS RANGE				
Thickness - mm         0.10         0.30				
Quantity				

- Position a shim (5) with dimension (S) on bearing (4).
   See: fig.13.
- Assemble bearing (7) with a soft hammer.
   See: fig.14.



Fig.13



Fig.14

8. Assemble bush (2) on input shaft (1) with special tool

CA715829 (only for 24+24 models).

**See:** sec. E.1 (Clutch housing - syncro shuttle - syncro splitter).

9. Assemble on shaft (1) shim (3) 0.5 mm thickness.

See: fig.15.

10. Assemble assy (15) with buffer CA715848.

See: fig.16 and sec. E.1 (Clutch housing - syncro shuttle - syncro splitter).





Fig.16

Fig.15

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#### 11. Assemble shim (8).

See: fig.17.

12. Assemble seal (10) (present only 12+12 models) with tool CA716170.See: fig.18 and sec. E.1 (Clutch housing - syncro shuttle)



Fig.17



Fig.18

**13.** Assemble bearing (**12**) with tool CA715848 on input shaft (**1**).

See: sec. E.1 (Clutch housing - syncro shuttle - syncro splitter).

- 14. Assemble a new O-Ring (13) on cover (11) (only for 12+12 models).
- 15. Assemble a new seal ring (14) (only on 12+12 models) on shaft (1), with tool CA716134.
  See: sec. E.1 (Clutch housing syncro shuttle syncro splitter).





Assemble synchronizer kit on preassembled shaft.
 See: sec. D.19 and fig.19.

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17. Fit the shaft by inserting it from the upper side of gear box.See: fig.20.



Fig.20

**18.** Attach input shaft to primary shaft.

See: fig.21.

19. Position bearings in their seats with the help of a pad and a hammer.See: fig.22 and 23.



Fig.21



Fig.22



Fig.23

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**20.** Assemble cover (**11**) and tighten screws (**9**) to prescribed torque.

See: sec. C.4.



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# D.19 Synchro shuttle (replacement)

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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#### **D.19.1 Disassembly**

1.

**Warning:** always apply reference marks between lever and pin to be able to identify their correct position during assembly.

See: fig.1.

2. Remove screw (2) and washer (1) of the reverser fork (3), 3rd/4th (a) and 1st/2nd speed (b).

See: fig.







3. To release the reverser pin (4) and the 1st/2nd (a) and 3rd/4th (b) speed pins:

- Remove dowel pins from gear block 3rd/4th (a) e 1st/2nd speed (b).

**See:** fig.3.

- 4. Remove sensor (9).
- 5. Unscrew control position screw (5) of the reverser pin (4), pin 3rd/4th screw and 1st/2nd speed screw.

See: fig.4.







6. Move 3 rods.

Note: move speed control pins.

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- Remove reverser fork (3), replace it if worn.
   See: fig.5.
- 8. Remove clutch housing.

See: sec. D.6.

9. Remove idle gear.

See: sec. D.16.

10. Remove the 4 cover's screws (input shaft) and remove cover.







Fig.6

- 11. With the help of a screwdriver and using puller CA716202 detach input shaft from synchro shuttle.See: fig.6 and sec. E.1 (Clutch housing syncro shuttle).
- 12. Remove reverser synchronizer kit (21) from primary shaft. Replace it if necessary.





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Warning: we wish to advise that transmissions could be equipped with two kind of synchronizer.

#### See: fig.7 and 8.

The synchronizer assemblies are interchangeable but single components are not interchangeable. For more detailed information look spare parts catalogue.

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#### 13.

**Note:** components of synchronizer reverser. **See:** fig.9.





#### D.19.2 Assembly

- Assemble reverser synchronizer kit (21) on the input shaft.
   Note: correct assembly of synchronizer reverser inserts.
   See: fig.10 and sec. D.18.
- 2. Assemble input shaft.

See: sec. D.18.

- Check end float [5] or [5a].
   See: sec. C.6.
- 4. Tighten 4 cover screws to prescribed torque. **See:** sec. C.4.
- 5. Assemble idle gear.

See: sec. D.16.

**6.** Assemble clutch housing.

See: sec. D.6.

- 7. Assemble reverser fork (3) on the rod. See: fig.5.
- Assemble screw (2) and washer (1) on the reverser fork
   (3).
- **9.** Tighten control position screw of the reverser pin to requested torque.

See: fig.4 and sec. C.4.

Adjust reverser fork (3) with screw (2).
 See: fig.2.



Fig.10

11. Restore initial position of the fork rods 3rd / 4th (a) and 1st /2nd speed (b) with relevant washers and screws.

See: sec. C.4.

**12.** Tighten 3rd/4th speed pin screw and 1st/2nd speed pin screw to requested torque.

See: fig.4 and sec. C.4.

**13.** Assemble the dowel pins of 3rd/4th and 1st/2nd gears control block.

See: fig.3.

**14.** Assemble reverser pin control screw, 3rd/4th speed pin screw and 1st/2nd speed pin screw.

See: sec. C.4.

- **15.** Repeat steps 8-14 also for speed control pins.
- **16.** Assemble sensor (9) to prescribed torque.

See: sec. C.4.



# D.20 Speed gears (primary shaft)



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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#### **D.20.1 Disassembly**

- 1. Remove snap ring (1). See: fig.1.
- **2.** Remove shim (**2**).
- **3.** Remove middle bearing (**3**).



Fig.1

- 4. Remove screws (25).
- 5. Remove cover (24).
- Remove input shaft (13) assembled with its components from the gear box.
   See: sec. D.18.
- 7. Remove from primary shaft (4) FRW-REV synchronizer (12, 11, 10, 9, 8, 7, 6).Note: to disassemble other parts from input shaft see section D.18.
- 8. Remove primary shaft (4). Remove bearing (5) from the primary shaft (4).

#### **D.20.2 Assembly**

- Assemble input shaft with all its components.
   See: sec. D.18.
- Assemble synchronizer kit (12, 11, 10, 9, 8, 7, 6).
   See: fig.1.
- Turn input shaft (13) and assemble synchronizer kit.
   See: sec. D.18.
- Assemble input shaft inserting it from upper side of gear box (23).
   See: sec. D.18.
- 5. Assemble bearing (5) on the primary shaft (4) using an appropriate tool.
- Assemble primary shaft (4).
   See: fig.2.
- Settle groups with special tool CA715821 and CA715830. Check that groups rotate freely.
   See: sec. E.1 (Gear box) and fig.3.
- 8. Assemble cover (24).
- 9. Tighten screws (25) to the requested torque. See: sec. C.4.
- **10.** Assemble bearing (**3**) on the opposite side of the primary shaft (**4**) with special tool CA715821 and CA715830.

See: fig.4 and sec. E.1 (Gear box).

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Fig.1



Fig.2



Fig.3





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- **11.** Assemble snap ring (**1**).
- Proceed as follows to determine end float [3]: measure value (A) with a thickness gauge, that is end float between bearing (3) and snap ring (1). Lubricate and assemble shim (2). Reassemble snap ring (1). Check again value (A) and repeat operations described previously so as to obtain an end float value included in the prescribed range: 0.15-0.25 mm.

See: sec. C.6 and fig.5 and 6.

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Fig.5



Fig.6

### D.20.3 Primary shaft covers

### 1.

Note: covers assembled on 12+12 synchro shuttle transmission models. See: fig.7.



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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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## **D.21 Differential assy**



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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#### D.21.1 Disassembly

1. Before starting disassembly, use a dynanometer whose cord is wound on the pinion ring nut with diameter **D**=80 mm to check for bearing preload. If during assembly bearings are not changed, expected load will have a value 40-50% lower than expected for new bearings.

See: fig.1 and 2.





- 2. Disconnect brake control.
- 3. Disassembly screws (1).
- 4. Remove brake (2).
- 5. Remove right flange (4).
- 6. Remove bearing cup (14) from right flange (4).

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- 7. Repeat same operations from the other side (left side).
- 8. Remove bearings cones (14) and (7) from differential box (17).
- 9. Remove screws (12) and disassemble bevel gear crown (13).
- 10. Remove screws (9).
- 11. Remove carter (8).





### D.21.2 Assembly

1. Assemble carter (8).

See: fig.3.





- 2. Assemble screws (9) to requested torque. See: sec. C.4.
- **3.** Check carter adjustment (it must not chatter).
- 4. Assemble differential box (17) as shown in the figure.

See: fig.4.

Note: position of pin on differential gear.

See: fig.5.

**Note:** correct assembly of springs and pins of differential box. **See:** fig.6.



Fig.5

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Fig.6



Note: correct position of differential locking sleeve on differential box.

See: fig.7.

- 5. Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.
- 6. Place bevel gear crown (13) on differential half box (17).
- Apply prescribed sealant on the thread and tighten screws (12) to the requested torque.
   See: fig.8 and sec. C.4.



Fig.7





8. Assemble cones of bearings (14) and (7) on the differential box (17) with the special tool CA715093.
 See: sec. E.1 (Gear box).

Note: calculate shims quantity (11) and (10) to be used if replaced or flanges (4) and (6) or differential (17). If parts (4), (6) or (17) are not replaced, use shims collected during disassembly.



9. Choose shims (11) and (10) with total thickness of 1.0 mm (necessary for first check), among available shims range. Assemble into flanges (4) and (6) shims (11) and (10).

See: fig.9.

Shims Range					
Thickness - mm	0.05	0.10	0.30	0.50	
Quantity	—	—	—	—	

10. Assemble bearings cups (14) and (7) to differential support flanges. If necessary use special tool CA715583.See: fig.10 and sec. E.1 (Gear box).



Fig.9

**11.** Assemble differential assy.

See: fig.11.

**12.** Assemble flanges (**4**) and (**6**). **See:** fig.12.





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Fig.10



Fig.12

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**13.** Assemble brake flange without brake assy. Tighten 5 screws (1).

See: fig.13.

14. Measure pinion-bevel gear crown backlash. The measured backlash value must be within the prescribed range: 0.10-0.30 mm

See: fig.14.



Fig.13

15. Choose shims (11) and (10) among the range available.



Fig.14

Shims Range					
Thickness - mm	0.05	0.10	0.30	0.50	
Quantity	—	—	—	—	

See: fig.15.

- 16. Adjust shims (11) and (10), remembering that:
  - [a] if the measured backlash is less than given tolerance range, increase shims (10) from the side opposite to bevel gear crown and decrease shims (11) of the same measure;
  - [b] if the measured backlash is greater than given tolerance range, increase shims (11) from the side of bevel gear crown and decrease shims (10) of the same measure.

See: fig.16.





Fig.16

I.	т	L	E-117	SERVICE MANUAL

- 17. Once pinion-bevel gear crown backlash has been established, measure total preload T of bearings (pinion-bevel gear crown system). Use a dynamometer whose cord is wound on the pinion ring nut with diameter D= 80 mm. The measured value should be within following range:
  - for T1 and T5 models T= (P+6.3) to (P+9.5) N
  - for **T2** models T= (P+7.0) to (P+11.0) N
  - for T3 and T4 models T= (P+5.9) to (P+8.8) N

Warning: values for new bearings.

See: fig.17 and 18.

If bearings are not new, measured value should be starting value.

See: sec. D.21.1.1.



Fig.17

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- **18.** If the measurement is not within the requested range, check the assembly of each component and operate on the shims (11) and (10) remembering that:
  - [c] if the total preload is less than given range, increase shims (11) and (10) by same measure, keeping pinion-bevel gear crown backlash value unchanged;

[d] if the total preload is greater than given range, decrease shims (11) and (10) by same measure, keeping pinion-bevel gear crown backlash value unchanged.

See: fig. 19.

- **19.** Remove screws (1) and brake flange (2).
- 20. Fasten with screws differential support flange (4).
- **21.** Assemble with tool 2 pins (**3**) using tool CA715815.

See: fig.20 and sec. E.1 (Gear box).





22. Remove screws.

See: fig.21.

23. Assemble preassembled brake (2).

See: fig.22.





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Fig.20



Fig.22

E-119
- **24.** Look for position of screw holes.
- 25. Assemble 5 screws (1) and tighten to the requested torque.See: fig.23 and sec. C.4.
- 26. Check bevel gear crown backlash.
- 27. Connect brake control.

See: fig.24.



Fig.23

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Fig.24

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T.

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		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		Worldtrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		Worldtrac

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## **D.22.1 Disassembly**

- 1. To disassemble pinion assy, it is necessary to remove: final drives, differential and shaft for slow speeds assy.
- 2. Use a dynanometer whose cord is wound on the pinion ring nut with diameter **D**= 80 mm to check for bearing preload. If during assembly bearings are not changed, expected load will have a value 40-50% lower than expected for new bearings.

See: fig.1 and 2.







Fig.2

3. Unscrew ring nut (9).

**Note:** destructive operation for ring nut.

- 4. Remove pinion (15).
- 5. Collect: bearing (11), gear (10), ring nut (9), thrust washer (8), bearing needles (6) and (7), gear (5), spacer (4), collar (3), central clutch (2) and thrust washer (1).
- 6. Remove inner cups of the bearings (11) and (13).

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7. Remove spacer (14) and bearing (13) from the pinion (15).

#### D.22.2 Assembly

1. Assemble outer cups of the bearings (11) and (13) using the tool CA715808.

See: sec. E.1 (Gear box).

2. The value of bevel distance (V) to be obtained is printed on pinion (15) head and corresponds to distance between differential axis and pinion head base.

See: fig.3.

- 3. Assemble differential box supports and fasten them with screws M12.
- 4. Prepare kit "false pinion" consisting of the special tool (s1) CA715800 with nut ring (s2), kit "false differential box" CA715810 consisting of the special tools (s3) and (s4) and a depth gauge.

See: fig.4 and sec. E.1 (Gear box)



Fig.3

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5. Insert false pinion (s1) with bearing cones (11) and (13) in the related housings then assemble nut ring (s2). Screw in without exceeding nut ring (s2) till the end float is eliminated. Install false differential box (s3, s4).

See: fig.5.

- 6. Measure distance X (distance between the axis of the differential bearings and the base of pinion head) with a depth gauge. See: fig.5.
- 7. In order to determine necessary thickness value (S) between pinion and bearing, subtract value (V), stamped on the pinion head (V=requested distance), from the measured value (X).

S=X-V mm





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Fig.6



#### See: fig.6.

8. Choose shim (14) with thickness value (S) among range available and fit it on the shaft under the pinion head.

Shims Range											
Thickness - mm	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5
Quantity	—	—	—	_	—	—	—	_	—	_	—

- 9. Remove false differential box (s3, s4). Unscrew ring nut (s2) and remove false pinion (s1) and bearing cones (11) and (13).
- Once you have chosen and inserted suitable shim (14) with chamfer against the gear, force bearing cone (13) into the pinion shaft (15) using special tool CA716171. Assemble pinion assy to the transmission.

See: fig.7 and sec. E.1 (Gear box).

- 11. Assemble inner cup of the bearing (11) into the box (12).
- 12. Assemble following group (g): gear (10), ring nut (9), thrust washer (8), bearing needles (6) and (7), gear (5), spacer (4), collar (3), central clutch (2) and thrust washer (1).

Note: right position for central clutch (2).

See: fig.9.

Note: grease thrust washers (8) and (1) so that they do not fall on the gear box.

See: fig.10 and 11.

**13.** Settle group (g) into the gear box (12) and insert pinion (15) into the box (12) and in the group (g).

See: fig.8 and 9.



Fig.7



Fig.8



14. To assemble pinion assy use special tool CA716144.See: fig.9 and sec. E.1 (Gear box).



Fig.9



Fig.10



Fig.11

**15.** Screw ring nut (9) on the pinion shaft (15) using prescribed tool.

See: fig.12, 13.

Warning: torque setting is given by preload measurement on the ring nut (9); tighten ring nut gradually.

**Note:** when you check preload, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting bearings.

**16.** Alternatively, to fasten ring nut use commercial key as shown in the figure.

See: fig.14.



Fig.12

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Fig.13



Fig.14

17. To measure preload (P) of the pinion taper roller bearings, use a dynamometer whose cord is wound on the ring nut (9). The effectively preload (P) is measured on D= 80 mm. The measured value should be within following range:

P= 40 to 60 N

Warning: values valid for new bearings.

See: fig.15.

If bearings are not new, measured valve should be starting value.

See: sec. D.22.1.2.

18. Once requested preload value is achieved, caulk ring nut (9), using a hammer and a chisel from both sides.

See: fig.16.

Note: caulk as shown.

See: fig.17.





Fig.15

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# D.23 Speed gears (secondary shaft)



		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac

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## **D.23.1 Disassembly**

**Note:** to remove secondary shaft (1) it is necessary to remove pinion assy. **See:** sec. D.22.

- 1. Remove cover (**30**) with relevant screws (**31**).
- 2. Remove snap ring (29).
- 3. Remove spacer (28).
- 4. Remove cover (26) from gear box (25).
- 5. Take bearing (27) out of cover (26).
- **6.** Remove shim (**24**).
- Move shaft (1) backward and remove secondary shaft assy (1+2+3) from the opposite side.
  See: fig.1.



- 8. Take bearing (23) out.
- 9. Remove snap ring (22).
- **10.** Remove bush (**21**).
- **11.** Remove gear (**20**).
- 12. Remove assy (C) from gear box (25).
- 13. Assy (C) disassembly. Disassemble assy (C) in the following order: synchro ring (18), hub (17), sleeve (16), synchro ring (15), gear (14), bush (13), gear (12), sleeve (11), synchro ring (10), hub (9), sleeve (8), synchro ring (7), clutch ring (6), bush (5) and gear (4).
- 14. Remove spacer (3) and bearing (2) from secondary shaft (1).
- 15. Remove needles (36) and bush (35).

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## D.23.2 Assembly

- 1. Assemble bearing (2) and spacer (3) on secondary shaft (1).
- 2. Lubricate needles (36) and insert them in the shaft.
- 3. Lubricate bush (35) and insert it in the shaft.
- Assy (C) preassembly. Assemble assy (C) in the following order: assemble bush (5) into gear (4); assemble 1st-2nd speed synchro kit (32) made of: snap ring (6), synchro ring (7), sleeve (8), hub (9), synchro ring (10), sleeve (11); assemble gear (12), bush (13), gear (14); assemble 3rd-4th speed kit synchro (33) made of: synchro ring (15), sleeve (16), hub (17) and synchro ring (18).

See: fig.2, 3, 4, 5 and 6.



Fig.2



Fig.3



Fig.4

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E-131

Fig.6

- Insert assy (C) in the gear box (25).
  See: fig.7.
- 6. Assemble gear (20) and bearing (19) with tool CA715843.See: fig.8 and sec. E.1 (Gear box).



Fig.7

Overturn gear (20) then assemble snap ring (22).
 See: fig.9.



Fig.8



Fig.9

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- 8. Assemble bearing (23) using tool CA715843.See: fig.10 and sec. E.1 (Gear box).
- Assemble secondary shaft assy (1+2+3) from the opposite side.
  See: fig.11.





- **10.** Insert bush (**21**). **See:** fig.12.
- 11. Assemble pinion assy. See: sec. D.22.



Fig.11



Fig.12

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### D.23.3 End floats 1 and 2 determination

1. Make sure that secondary shaft assy rests on the gear box. Use if necessary tool CA716144. **See:** fig.13 and sec. E.1 (Gear box).



Fig.13

2. Assemble spacer (24).

See: fig.14.

**3.** Assemble bearing (**27**) into the cover (**26**) using prescribed tool.

See: fig.15.





Fig.15

Fig.14

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- 4. Assemble cover (26) to the gear box (25).
- 5. Assemble spacer (28).
- 6. Assemble snap ring (29).

See: fig. 16.



Fig.16

- 7. Assemble cover (30) with at least two screws.
- Check end float 1 and 2. If end float is lower than expected 0.2÷0.3 mm, remove shims from B and place them to A. If end float is higher than expected 0.2÷0.3 mm, remove shims from A and place them to B. Then proceed as follows: remove cover (30) and screws (31); remove snap ring (29) and shims (28); Remove cover (26) using tool CA715814; assemble shims (24) to position B. Repeat steps from 3 to 7.

See: fig.17 and 18 and sec. E.1 (Clutch housing - syncro shuttle).



Fig.17

9. Tighten screw (31) to the prescribed torque. See: sec. C.4.

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10. Check preload of bearings on the pinion ring nut.



Fig.18



# **HYDRAULIC CIRCUIT**

# CONTENTS

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F 4.0	CONTROL LEVER ASSY	F-5
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# F.1.0 Hydraulic Circuit of Power Lift



No.	PART NAME	Qty.
1	Hydraulic Pump	1
2	Inlet manifold Assembly	1
3	HYDRAULIC FILTER	1
4	Suction pipe From Strainer to hose	1
5	Strainer	1
6	Control Valve	1
7	Sec Pipe from pump to rear cover	1
8	Lift Housing	1
9	Gasket	1
10	DCV Lever	1
11	Directional Control Lever	1
12	Flexible pipe From DCV to QRC	2
13	DCV Outlet Pipes Support	1
14	Lift arms	2

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# F.2.0 Hydraulic Control Valve Part Details



No.	Models	Reference	Description	Qty.
1	ALL MODELS	10081088AA	DISTRIBUTOR	
2	ALL MODELS		NOT AVAILABLE AS SPARE PARTS	
3	ALL MODELS	10081089AA	VALVE	1
4	ALL MODELS	10081090AA	VALVE WHIT RINGS	1
5	ALL MODELS		NOT AVAILABLE AS SPARE PARTS	
6	ALL MODELS	10081091AA	PLUG M14X1	1
7	ALL MODELS	10081092AA	SPRING De=8,2 L=40	1
8	ALL MODELS	10081093AA	PARBAK B-016 D15,6	1
9	ALL MODELS	10081094AA	PARBAK B-018 D18, 7	1
10	ALL MODELS	10081095AA	OR 15, 6 TI, 78 80/90SH	2
11	ALL MODELS	10081096AA	OR D18, 77X1, 78 70/80SH	1
12	ALL MODELS	10081097AA	SPACER	2
13	ALL MODELS	10081098AA	COVER	1
14	ALL MODELS	10081099AA	GASKET DIN 936	2
15	ALL MODELS	10081100AA	FRICTION INSERT	2
16	ALL MODELS	10081101AA	RING NUT MIOxlh	1
17	ALL MODELS	10081102AA	PLATE	1
18	ALL MODELS	10081103AA	SPACER 6/12X5	3
19	ALL MODELS	10081104AA	VALVE	1
20	ALL MODELS	10081105AA	VALVE SEAT	1
21	ALL MODELS	10081106AA	VALVE	1
22	ALL MODELS	10081107AA	LEVER	1
23	ALL MODELS	10081108AA	VALVE SEAT	1
24	ALL MODELS		NOT AVAILABLE AS SPARE PARTS	
25	ALL MODELS	10081109AA	SCREW M6X25 DIN 912-BG	3
26	ALL MODELS	10081110AA	SCREW M6X16 DIN 912-BG	3
27	ALL MODELS	10081111AA	DOWEL M8X20 DIN 915 12.9	2

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# F.3.0 Hydraulic Control Valve Part Details

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No.	Models	Reference	Description	Qty.
28	ALL MODELS	10081112AA	SCREW TCEI M6X16 DIN 912-BG	3
29	ALL MODELS	10081113AA	NUT M8 PAL DIN 7967	2
30	ALL MODELS	10081114AA	SPRING De=6,5 L=32	1
31	ALL MODELS	10081115AA	SPRING D11X30	
32	ALL MODELS	10081116AA	SPRING	
33	ALL MODELS	10081117AA	SPRING	
34	ALL MODELS	10081118AA	PARBAK 8-225 D47,2	
35	ALL MODELS	10081119AA	OR D47, 63 T3,53 80/90SH OR	
36	ALL MODELS	10081120AA	3,53X58,74HS80-90 OR D12, 37	
37	ALL MODELS	10081121AA	TP,62 P80-90 OR D3,68X1,78	
38	ALL MODELS	10081122AA	80/90SH OR D12,42 T1, 78	
39	ALL MODELS	10081123AA	80/90SH OR D=14X1.78 SH 80/90	
40	ALL MODELS	10081124AA	ELASTIC PIN 4X36 DIN 7343	
41	ALL MODELS	10081125AA	BUSH M6/14	
42	ALL MODELS	10081126AA	BUSH	
43	ALL MODELS	10081127AA	BALL	
44	ALL MODELS	10081128AA	BALL 9/32' D=7, 144	
45	ALL MODELS	10081129AA	PIN D4X19,8	
46	ALL MODELS	10081130AA	LEVER	
47	ALL MODELS	1008113`AA	SPACER	
48	ALL MODELS	10081132AA	GASKET DIN 936	
49	ALL MODELS	10081133AA	SPEAL KIT CONTROL VALVE	
			POS=8-9-10-11-14-34-35-36-37-38-39-40	

SERVICE MANUAL

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# F.4.0 Control Lever Assy.



F-4

No.	Models	Reference	Description	Qty.
1	ALL MODELS	10081016AA	SEEGER E16 UN17435	1
2	ALL MODELS	10081075AA	SHAFT	1
3	ALL MODELS	10081076AA	SCREW TE M8X55 U55 U9531 8G 2N	2
4	ALL MODELS	10081077AA	SCREW TCEI M8X30 U59318G 2N	1
5	ALL MODELS	10081078AA	POSITION LEVER	1
6	ALL MODELS	10081080AA	LOCKERD8.1 DIN 7960	2
7	ALL MODELS	10081081AA	SCREW TCEI M8X40 U5931 8G ZN	2
8	ALL MODELS	10081082AA	SPRING	2
9	ALL MODELS	10081083AA	OR 3043 D=10.77X2.62 SH 70/80	1
10	ALL MODELS	10081084AA	DRAFT LEVER WITH SHAFT	1
11	ALL MODELS	10081085AA	FRICTION	2
12	ALL MODELS	10081086AA	CLUTCH HUB	2
13	ALL MODELS	10081087AA	OR D=20.24X12.62 70/75SH	1
14	ALL MODELS	10081070AA	COMMAND SUPPORT	1
15	ALL MODELS	10081126AA	SCREW M8X25 UNI5931 8G	2
16	ALL MODELS	10081127AA	FITTING 90 M10X1-GREASE NIPPLE	1

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Unscrew the Bolts from Lift HousinG (Fig.1).

Unscrew two Bolts to Remove Control Valve assy (Fig.2).

Pull Out the Control Valve assy (Fig.3).

Pull Out the Control Valve assy (Fig.4).



Fig.1



Fig.2



Fig.3



Fig.4

Keep the Control Valve Assy in Dust free Area (Fig.5).

Dismantle and Clean this valve carefully (Fig.6).

Unscrew the Eight bolts to dismantle its Ram cylinder And Piston assy (Fig.7).

Lift the Ram cylinder and Piston assy (Fig.8).

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Fig.5



Fig.6



Fig.7



Fig.8

F-6

Unscrew the three bolts to remove DCV assy (Fig.9).

Please ensure that the O'Ring seals are not damage(Leack) (Fig.10).

Please ensure there is no excess free play in linkage assy and lock is properly fitted in the groove (Fig.11).

Please ensure there have no excess free play in Draft Lever and also draft setting done from this lever (Fig.12).

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Fig.9



Fig.10



Fig.11



Fig.12

SERVICE MANUAL

# F.5.0 Cleaning of Hydraulic Control Valve

Unscrew two nuts from topside (Fig.13).

Keep the bush carefully (Fig.14).

Pull out spool valve from Assy (Fig.15).

Dismantle Valves Carefully (Fig.16).

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Fig.13



Fig.14



Fig.15



Fig.16

SERVICE MANUAL

Keep valve seat and needle carefully at clean place (Fig.17).

Please keep Valve Body carefully (Fig.18).

Please do not interchange the Springs (Fig.19).

Kindly Grease Properly (Fig.20).



Fig.17



Fig.18



Fig.19



Fig.20

SERVICE MANUAL

Kindly Grease Properly (Fig.21).

Fig.21



Fig.22



Fig.23



Fig.24

Remove Circlip Lock and Pull out lifting Arm (Fig.22).

Remove Spacer Cum Shim from Rocker Shaft (Fig.23).

Remove Oil Seal from Rocker Arm (Fig.24).

F-10

Match Mark Mention on Rocker shaft and Lift Arm (Fig.25).

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Fig.25

# Procedure for utilizing the Direction control valve For Worldtrac models 1. Push the lever (1) forward to operate the lever so that the oil will come out from A port. 2. Pulling the lever (1) back will operate the B port so that oil will come out from B port. Backwards to Forward to operate the B operate the A port port B 3. Where ever there is use of single acting cylinders, unscrew the pin (2) using an (open end spanner 6 no.) and use the Quick release coupler (male) in **B port only**. Do not use the male coupler in **A port** whenever single acting DCV is used. 4. In order to use the DCV in double acting position, screw the pin (2) using an (open end spanner 6 no.) \*Note: The oil will come out of both the couplers even in single acting (the check valve will be opened and the A port oil will be routed back to tank), but in case of double acting, the check valve will be closed so the oil will not be routed back to tank and will be coming out of the A port as well as B port. So never use double acting setting if only single coupler is used. WARNING: Use the correct setting according to the application. Always use single coupler for single acting and double for double acting condition but with correct setting of the Pin (2) F-10 SERVICE MANUAL



# **INSTRUCTION MANUAL**

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# M 1.1

### **TECHNICAL FEATURES**

- Operation with Draft and Position Control
- Operation sensibility adjusting.
- Lowering speed adjustment of lifting arms.
- Safety transport lock on control valve.
- Automatic hydraulic limit stop of angular excursion of lifting arms.
- Two command levers : one lever for the position and one for the draft control.
- Possibility to assemble auxiliary valves on right side
- Rockshaft functions with transmission oil
- Oil filter not built-in
- Required degree of filtering : 20-25 um
- Maximum functioning temperature : 90°c

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### **DIMENSIONAL FEATURES**

•	Piston Diameter	110 mm
•	Working Stroke	102 mm
•	Piston Displacement	969 cm <sup>3</sup>
•	Angular Excursion of Lifting Arms in Position Control	70° - 72°
•	Intervention of Automatic Hydraulic Limit Stop	73° - 74°
•	Internal Mechanical Limit Stop	$76^{\circ}$ - $78^{\circ}$
•	Angular Excursion of Control Position Lever	68°

## CALIBRATION SETTINGS OF CONTROL VALVE

•	Relief Valve Calibration :				
	Dynamic With 15-20 L/min	190 - 195 bar			
•	Safety Valve Calibration :				
	Static with 2-3 L/min	220 - 225 bar			

# CIRCUIT DIAGRAM OF HYDRAULIC LIFTING DEVICE



## M 4.1

### OPERATION OF POWER LIFT CONTROL VALVE ON OFF.

The control valve is pre-set to obtain three distinct phases :

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- a) Neutral Phase
- b) Delivery Phase
- c) Discharge Phase

#### a) Neutral Phase

In this phase the control valve keeps pressure on the oil contained in the cylinder thus allowing the oil coming from the pump to flow freely to the tank.

In this phase the control spool "1" is in such a position to connect the chamber "5" of the differential valve "2" directly to the discharge through hole "6".

The oil coming from the pump enters the annular duct "8" and moves the differential valve "2" upwards which then opens the discharge hole "7" and enables the oil to go to the tank.

The oil contained in the cylinder (Chamber 9) is kept under pressure by the check valve "3" by the discharge valve "4" and by the safety valve "10" connected to the cylinder "9" by the annular duct "11" thus holding the load applied to the lifting arms.

G-3

The safety valve "10" secures protection from any possible over-pressure during the implement movement.

M 4.2



G-4

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## M 4.3

### a) DELIVERY PHASE

During this phase the Control Valve supplies the oil under pressure to the cylinder "9" and it consequently lifts the arms.

The control spool "1" is in such a position to connect the chamber "5" of the differential valve "2" with the oil coming from the pump through annular duct "8" and holes "12" and "13" making in this way the valve itself to close.

The Oil from the pump finding the differential valve "2" closed goes to cylinder, pass the hole "14" opens the check valve "3" enters in the annular duct "11" and enters the chamber "9"

The lifting speed depends on the pump rpm.

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In this phase the maximum lifting pressure is controlled by the safety valve "15" that is connected to the annular duct "8" through hole "14" and then to the oil inlet.

G-5





G-6

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## M 4.5

## a) DISCHARGE PHASE

During this phase the control valve supplies at the same time the oil coming from the pump and the oil contained in the cylinder to the discharge causing the lowering of the arms.

The control spool "1" is in such a position to connect chamber "5" of differential valve directly to the discharge through hole "6".

The Oil coming from the pump enters the annular duct "8" and moves the differential valve "2" upwards which then opens the discharge hole "7" and enables the oil to go to the tank.

At the same time the pressure oil contained in the cylinder (chamber "9") flows to the tank therefore causing the lowering of arms.

From chamber "9" the oil goes into the annular duct "11" passing the lowering speed regulation valve "16" through the connecting hole "17" enter into the discharge valve "4" that is kept open from the spool "1" and goes to discharge from hole "18".

G-7

In this phase the lowering speed of the implement can be adjusted with the lever AD.





G-8

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## M 5.1

## HOW THE INTERNAL LEVERAGE SYSTEM FUNCTION

a) Functioning of Position Control

- b) Functioning of Draft Control
- c) Combined Function of Position and Draft Control

## a) FUNCTIONING WITH POSITION CONTROL

By positioning the draft control lever "2" against the backstop "E" (Fig. Page M 5.2 and 8.1) the roller "11", which slides on the flywheel "7" of draft cam "12" will be moved away completely.

In this way the draft levers will not in any way interfere with the operation of the position control.

The arms are raised by moving the position control lever "1" upward, and the leverage system will act in the following way :

Crank "4" being an integral part of shaft "3" turns in a clockwise direction and causes roller "5" to slide on the position cam "6", in tum causing the clockwise rotation of flywheel "7". The flywheel will transmit an anticlockwise rotation, by means of friction shock absorber "8" to the transmission lever "9" that will bring distributor shaft "21" into delivery position "C", thus causing the arms to be lifted.

During the lifting movement of the arms, crank "13" with pin "10" will rotate in an anticlockwise direction, and by means of the link "14" will cause position cam "6" to rotate clockwise.

When the roller "5" meets the inclined plane of the cam "6", It allows the anti-clockwise rotation of the flywheel "7" that by means of a friction shock absorber "8" rotates the lever 9" in a clockwise direction, which is pushed by the spring of the control valve shaft "21" which moves to position "N" (neutral phase) and thus blocking the movement of the lifting arms.

During the lowering phase of the arms the movements of the levers indicated above will occur in the opposite sense.

The position of the arms, during lifting and lowering, correspond to a specific position of the position control lever "1".

M 5.2



## M 5.3

## b) FUNCTIONING OF DRAFT CONTROL

By positioning the control lever "1" for position control against the backstop "E", the crank "4" (Fig. Page M 5.2 and 4.4) reaches its maximum position of anti-clockwise rotation. In said position the roller "5" is totally lowered from the inclined plane of position cam "6" allowing the anti-clockwise rotation of flywheel "7" as well as the clockwise rotation of the transmission lever "9" that is pushed by the spring of shaft "21" which in turn will position itself for the discharge position "S". In this way the position levers will not interfere with the functioning of the draft control levers.

By positioning the draft control lever "2" against backstop "F" (Fig. Page 8.1) draft control shaft "16" is caused to rotate clockwise.

The crank "15" being an integral part of shaft "16" will reach its extreme position of clockwise rotation, and by means of tension rod "17" will move roller "11", the latter acting on the draft cam "12". This causes flywheel "7" to rotate clockwise which by means of function shock absorber "8" produces the anti-clockwise rotation of transmission lever "9" thus setting the distributor shaft "21" in delivery position "C" and consequently lifting the arms.

The arms will come to a stop only as soon as the piston comes into contact with the pin of the limit stop "22".

This limit stop, by means of tension rod "23" causes lever "9" to rotate clockwise, thereby compressing the spring of friction shock absorber "8" and thus releasing shaft "21" which now can move to the neutral position "N" where it is pushed outward by its spring.

Moving the draft control lever "2" toward backstop "E", the leverage system will function in the following manner :

The crank "15", being an integral part of the draft shaft '16", rotates counter-clockwise and by means of tension rod "17" causes roller "11" to slide on flywheel "7".

The roller "11", when it meets the inclined plane of the draft cam "12" permits the counter-clockwise rotation of flywheel "7" which by means of shock absorber "8" will rotate transmission lever "9" in a clockwise manner thus leaving distributor shaft "21" free to move into neutral position "N" and continuing the movement of lever "2", in the discharge position "S", causing the arms to lower.

In fact, during the initial part of the movement toward backstop "E", of draft control lever "2" the corresponding lowering of the arms does not happen yet.

The traction force on the top link point "20" acts on tension rod "18" in the direction indicated by the arrow  $\oplus$  "positive" causing flywheel "19" to rotate clockwise together with draft cam "12" which is fastened to the same pin.

When the inclined plane of draft cam "12" meets roller "11", a clockwise rotation of flywheel "7" is achieved which by means of shock absorber "8" will cause transmission lever "9" to rotate counter - clockwise thereby moving the distributor shaft "21" into neutral position "N" and stopping the movement of the arms.

As the traction force is increased, draft cam "12" will further move roller "11" thus incrementing the movement as described above.

The distributor shaft "21" will move from neutral position "N" to delivery position "C" causing the arms to be lifted. When the traction force diminishes, shaft "21" will return to the neutral position or to the lowering position which will mean an inverse movement of the leverage systems to what is described above.

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## C. COMBINED FUNCTIONING OF POSITION AND DRAFT CONTROL

(Fig. page 5.2 - 5.4)

To utilise the lifting device in this condition it is necessary to observe the following instructions :

• Move the position control lever "1" upwards with respect to the backstop "E" (Fig. page 8.1) until the maximum working depth has been attained.

• Determine the desired minimum working depth by operating the draft control lever and raising it from its zero position so that roller "11", acting on the draft cam "12", will move the distributor shaft "21" into the lifting position "C" and causing a further upward movement of the lifting arms.

Due to the position previously established by position control lever "1", flywheel "7", roller "4" and position cam "6", the distributor shaft "21" is prevented from entering the lowering position "S" and therefore the arms cannot sink even though the traction force acting on the top link point "20" will tend to diminish and putting stress on the tension rod "18" in the direction of arrow  $\Theta$  "negative".

This condition will not prevent the rockshaft from operating with the draft control when, in the presence of more consistent soil, the traction force on the top link "20" will tend to increase, exerting pressure on the tension rod "18" in the direction of arrow  $\oplus$  "positive".

Consequently the combined operation of position and draft control will limit variations in height toward the ground, as happens during the use of the draft control, and at the same time ensuring the maximum possible depth desirable.

## **USE OF CONTROL LEVERS**

The two control levers carry out following operations :

- A Position control.
- B Draft control.
- C Combined operation for position and draft control.

The above operations may be chosen in consideration of the work to be carried out, the implement type and the soil superficial hardness.



## A - POSITION CONTROL (lever 1)

Move the draft control lever 2 fully down. Fix the implement position, inside or outside the soil by moving the lever 1 up for raising and down for lowering.

The implement movement is proportional to the movement range fixed by means of lever 1.

## **B-DRAFT CONTROL (lever 2)**

Move the position control lever 1 fully down, have the implement penetrated into the ground till reaching the desired depth by gradually moving the lever 2 down.

The implement depth reached is proportional to the draft determined by soil hardness.

In this condition the rockshaft keeps the draft required automatically constant.

During last movement stroke of lever 2 a floating function is obtained and the rockshaft does not control the draft.

## C - COMBINED OPERATION FOR POSITION AND DRAFT CONTROL

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In case of operation carried out under draft control on non-homogeneous soils, during which excessive implement penetration may occur, it is convenient to use the combined position and draft control.

Have the implement penetrated into the ground and search for the desired working depth in the way described for the draft control.

When the desired depth is reached, gradually move up the lever 1 till the lower links slightly start raising.

G-16	S	Ε	R	۷	L	С	Е	Μ	Α	Ν	U	Α
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The rockshaft operates under controlled draft setting, but at the same time it prevents the implement from excessively penetrating into the ground causing a not very uniform work, when coming up against a less hard ground.

## **IMPORTANT :**

It is not correct to find the position with the draft lever 2 because the lifting and lowering of arms with this lever changes with the top link position.

This can be on neutral - positive - negative - position depending on the draft force or to the force on the top link bracket depending on the implement weight.

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## ADJUSTMENT OF CONTROL VALVE SENSITIVITY



Place the rockshaft arms, with a weight applied, at about the middle of their stroke so that the control valve is in the neutral phase.

Operate the control valve, turning in an anti-clockwise direction the sensitivity regulator "RS" until the rockshaft arms begin to jerk.

If the lever "RS" is in position "1" and the rockshaft arms still jerky, lower the weight and unscrew the screws "3" so that the lever "RS" can rotate freely anti-clockwise together with the threaded bushing for the adjustment of the sensitivity up to position "2", the bushing is covered with a plastic cap "4". Block the movement of the threaded bushing by tightening the screws "3", raise the load, and find again the position in which the arms jerk by slowly rotating anti-clockwise the lever "RS".

N.B.: Repeat the operation described above until the objective has been reached. Once the position in which the arms vibrate has been determined turn the lever "RS" clockwise until the arms stop moving and from that position rotate clockwise for 1/4 of a turn. Lower the load and loosen the screws "3" so that the lever "RS" can turn clockwise, together with the threaded bushing, until the lever "RS" reaches position "1" against the stop "RD".

Block the sensitivity bushing, covered with the plastic cap "4", with the screws "3". In this way the control valve is adjusted at its maximum sensitivity.

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To reduce the level of sensitivity turn the lever "RS" clockwise until the desired effect is achieved.

## FUNCTIONING OF THE SENSITIVITY OF THE CONTROL VALVE



The external lever RS (Regulator of Sensitivity) rotated gradually clockwise from position "1" towards position "2" (shaded) moves the valve body "5" towards inner side increasing the contact "R" between the body and the shaft of the discharge valve.

The increase in contact means that there is a longer stoke of the control shaft "6" to allow a delivery and discharge of the control valve.

The top link bracket, which by means of the internal levers, moves the control shaft, will have to make a longer stroke in order to raise and lower the rockshaft arms during the functioning of the draft control.

The more the lever RS is moved in a clockwise direction the more the sensitivity of the top link bracket is reduced which otherwise, in hard ground conditions, has the tendency to vibrate and thus the rockshaft does not function correctly.

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M 7.3



## M 8.1 ADJUSTMENT OF POSITION CONTROL LEVER

Completely lower the arms and apply a light weight.

The adjustment is carried out in order to establish the maximum raised position of the rockshaft's lifting arms.

Loosen the fastening screw "6" so as to free the position control lever "1" from the shaft "5".

With the draft control lever "2" against the backstop "E" bring the position control lever "1" against the backstop "F" without rotating the shaft "5".



Maintaining fixed the levers "1" and "2" and with a 13 mm. open end wrench rotate slowly in an anticlockwise direction the position control shaft "5" so as to raise the arms to their maximum raised position which is determined by the internal hydraulic limit stop. Since during the functioning of the position control the hydraulic limit stop must not be triggered it is necessary to have a safety margin of ~ 10 mm. In order to do this, rotate slowly in a clockwise direction the shaft "5" until the arms are lowered by the required safety margin.

At this point keep the shaft "5" fixed and with lever "1" against the backstop "F" keep the lever fixed with the shaft by tightening fully the fastening screw "6".

To control, raise and lower the arms by moving the position control lever "1" and control that the arms always reach the same position at their highest position.

Then by raising the draft lever "2" and lifting the arms the hydraulic limit stop is acting and is possible to check the additional stroke upwards of the arms that should be kept in 10-15 mm.

## M 9.1 ADJUSTMENT OF DRAFT CONTROL LEVER

This adjustment guarantees the raising of the lifting arms to their maximum raised position by moving the draft control lever "2" in the last part of its travel towards the backstop "F" also when the three point linkage is against the negative backstop (—).

The adjustment must be carried out without implements or loads applied to the three point linkage "20".

Position the lever commands "1" and "2" against the backstop "E" and bring the three point linkage "2" by means of specific extractor against the negative backstop (—).

With the motor running at minimum RPM slowly move the draft control lever "2" towards the backstop "F". The adjustment of the draft lever "2" is correct when the arms are raised and come to about 3 to 4 mm from the backstop "F".



With the engine speed at the minimum, lift draft lever "2" slowly.

With the position control set so that arms do not interfere with the draft feedback rod "T", set the draft lever to the neutral position that corresponds to the angle of 43°-46° degrees on the rochkshaft controls "1" and "2".

Adjust the yoke on the draft feedback rod "T", one revolution at a time until the precise location where the arms raise is found.

Tighten the yoke on the draft feedback rod "T" and set the locking nut.

## M 10.1 CONTROL OF ASSEMBLY OF REACTION SPRING

Before assembly, control that the pre-assembled components satisfy the measurement "L". This permits a pre-loading of the reaction spring of 0.5 to 1 mm.

If this measurement is not correct then the washer "A" should be substituted with one which has an adequate width.



The spring-loader "PM" must be assembled on the rod "TR" with loctite thread locking glue no. 243 so as to not pre-load the reaction spring.

Assemble the group "GM on the cover "C", which is inserted in the body of the rockshaft, and tighten with two hexagonal head screws M12 which block the flange "F" to the body.

One will note, by moving the rod "TR", an axial play. This play must be eliminated for the correct assembly of the group as follows :

Keep the rod "TR" fixed and rotate gradually in a clockwise direction the spring-loader until the axial play is eliminated.

Complete the assembly of the Top Link Bracket taking care to not rotate the rod "TR" during the tightening of the self-locking nut "D".

## M 11.1

## **MEASUREMENT CONTROL OF PUSH ROD**

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Ensure that the measurement between two pins 08 of the push rod is 51 0/+0.2 mm.

The control of the measurement of the push rod with respect to the control valve face is carried out after making all the adjustments.

With the rockshaft arms completely lowered and without loads or implements on the three point linkage (neutral position); position the two control levers "1 R" and "2R" against the backstop "E".



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In this position, pushing the internal push rod, verify with the appropriate gauge that the distance of 112 is correct. N.B.: If the measurement "X" is changed it is obligatory to re-adjust the position control lever and the draft control lever.

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## M 12.1

DRAWBACKS	CAUSES	REMEDIES
Jerks while Rockshaft lift	Insuficient oil level in the tank. Pump inlet fillter clogged. Infiltration of air into the pump inlet pipe.	Top up the level. Clean or replace the filter. Check the inlet pipe and any coupling and gasket.
Rockshaft does not operate.	Differential Valve blocked or dirty (Page 4.2 pos. 2)	Remove the control valve and unblock the regulator piston
The rockshaft does not descend over its entire travel.	Faulty adjustment of the position control lever "1"	Adjust position control lever (Page 8.1)
	Sensitivity not OK	Adjust sensitivity of Control Valve (Page 7.1)
The rockshaft does not descend.	Discharge Valve blocked (Page 4.2 pos.4)	Remove control valve and unblock or clean discharge valve Turn lever RD in anti-clockwise.
	Lever RD closed	
Lifting capacity does not match as prescribed.	Deterioration of the Control Valve seal rings.	Remove control valve and replace the external seal rings.
	Relief and Safety valves out of Calibration. Poor pump efficiency.	Control calibration of the valves. Replace the pump.
The rockshaft supports loads with difficulty, there is a rhythmic oscillation	Piston gasket worn.	Replace the gasket.
when the motor is on ; the load descends when the motor is off	Discharge Valve not adjusted (Page 4.2, pos. 4)	Adjust the sensitivity of control valve or substitute the valve Remove and adjust Control Valve
	Oil leakage from Safety Valve (Page 4.2 Pos. 10) Oil leakage from Check valve (Page 4.2 Pos.3)	Remove and adjust Control Valve
Rhythmic oscillation with the arms raised at back-stop and with the engine on	Incorrectly adjustment of position control lever which, at maximum raised height, causes the internal automatic back-stop to function	Adjust the position control lever (Page 8.1)
The position control does not function; the rockshaft raises and lowers only with the draft lever	Position control lever not adjusted properly	Adjust the position control lever (Page 8.1)
	Internal levers damaged	Overhaul the rockshaft
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## M 12.2

DRAWBACKS	CAUSES	REMEDIES
The rockshaft starts to lift, but it stops as soon as the load is put.	Tension rod measurement "T" is not correct (Page 8.1)	Adjust the draft control lever (page 8.1)
Working with the draft control, the implement drops too much or doesn't stay in the groove	Sensitivity of the Control Valve not properly adjusted	Adjust the sensitivity of the Control. Valve (Page 7.2)
The draft control does not function; the rockshaft raises and lowers only raises and lowers only with the position lever	Draft control lever not adjusted properly	Adjust the draft control lever (Page 8.1)

## **REPAIR MANUAL AXLE**

ITL G-26 SERVICEMANUAL



# **FRONT AXLE - 2WD**

## CONTENTS

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F 5.0	ASSEMBLY PROCEDURE FRONT AXLE POWER STEERING 2WD	H-6
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## **F1.0 INTRODUCTION**

The ITL front axle is rigid and pivoted at the center. As the track width of the tractor is adjustable. The front axle has provision to be extended on both sides. The extension of right side is called axle extension right and that of left side is called axle extension left. These axle extension are bolted with the help of special bolts to front axle beam adjustment. They are bolted by set of holes so that desired track can be achieved. Both left and right axle extensions are having provisions for holding king pin stub axle. These pins are supported inside the axle housing with the help of wrapped bushes.

The axle has to take bending load due to weight of the tractor and also torque loads due to braking of the wheels. For this reason front axle is made of l-section in the central portion.

S. NO	REFERENCE	POWER STEERING
1.	STEERING LOCK AGNLE	<b>43</b> °
	TURNING RADIUS (M)	2.62
2.	WITH BRAKES	2.02
	TURNING RADIUS (M)	2.26
	WITHOUT BRAKES	3.30
3.	CASTER ANGLE	<b>0</b> °
4.	CAMBER ANGLE	<b>2</b> °
5.	KIN PIN ANGLE	9.5°
6.	TILT ANGLE	11°

## FOR 4-CYLINDER

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## F 2.0 VIEW DETAILS OF FRONT AXLE PARTS



S. NO	DESCRIPTION	Qty
1	OIL SEAL (40*58.2*10)	2
2	PIVOT PIN	1
3	THRUST WASHER	2
4	SPRING WASHER B-8	1
5	HEX SCREW M8X1.25X30 8-8 SA2JS	1
6	INTEGRAL FRONT AXLE BRACKET	1
	(4 CYL. TYRE SIZE 7.50-16/16.9-28)	
7	LOCK PIN MTG BRACKET	1
8	HEX SCREW M8X1.25X30 8-8 SA3NS	2
9	SPRING WASHER B-8	2

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## F 3.0 DETAIL VIEW OF FRONT AXLE BEAM POWER STEERING-2WD

#### No. DESCRIPTION

- 1. FRONT AXLE BEAM ASSEMBLY.
- 2. KING PIN STUB AXLE ASSEMBLY (RIGHT).
- 2A. CASTLE NUT.
- 2B. SPLIT PIN.
- 3. KING PIN STUB AXLE ASSEMBLY (LEFT).
- 3A. CASTLE NUT.
- 3B. SPLIT PIN.
- 4. O-RING HOLDER
- 5. O-RING FOR THRUST PAD
- 6. THRUST BALL BEARING.
- 7. FELT RING FOR KING PIN.
- 8. LOCKING BLOCK FOR KING PIN.
- 9. HEX SCREW.
- 10. GREASE NIPPLE.
- 11. FELT RING STUB AXLE ASSY.
- 12. WEAR RING.
- 13. AXLE HUB.
- 14. GASKET FOR FRONT HUB CAP.

#### No. DESCRIPTION

- 15. FRONT HUB CAP.
- 16. HEX HEAD SCREW.
- 17. WASHER STUB AXLE.
- 18. WHEEL BOLT FRONT.
- 19. TAPPER ROLLER BEARING.
- 20. OIL SEAL.
- 21. TAPPER ROLLER BEARING.
- 22. HYDRAULIC CYLINDER ASSEMBLY.
- 23. SPLIT PIN.
- 24. SPRING WASHER B8.
- 25. SPRING WASHER B12.
- 26. HEX BOLT.
- 27. TIE ROD ASSEMBLY.
- 27(a). TIE TOD END ASSEMBLY.

27(b). ROD

- 27(c). RACK END ASSEMBLY.
- 28. DOWEL PIN.

## F 4.0 DISMANTLING PROCEDURE OF FRONT AXLE POWER STEERING 2WD

1. Put king pin stub axle assembly on work bench for further dismantling. Remove felt ring (7), thrust bearing (8), o-ring (5) & o-ring holder (4) from king pin stub axle as shown in fig. 1.

Remove front hub cap (15) by removing hex screw (16) along with spring washer (24) & with gasket (front hub cap) (14) as shown in fig. 2. open end spanner (13mm).

3. Now remove the bends of split pin (B) for the removal of castle nut (A). Afterwards remove locking washer (17) & then remove tapper roller bearing (19) from king pin stub axle assembly as shown in fig. 3 with the help of screw driver (32mm) close end spanner (32mm).

Remove axle hub from king pin stub axle.

2.

4. Now remove tapper roller bearing (21), felt ring (11), oil seal (20) & wear ring (12) from king pin stub axle as shown in fig.4

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5. Remove bolts (18) from axle hub (13) as shown in fig. 5. Remove grease nipple (10) from axle hub with the help of open end spanner (9mm).





SERVICE MANUAL

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## F 5.0 ASSEMBLY PROCEDURE FRONT AXLE POWER STEERING 2WD

- First of all, put axle hub (13) on hydraulic press. 1.
- Insert the bearing cones into Axle Hub on the hydraulic press, on both 2. sides.
- Insert the six wheel bolts (18) into the Axle hub. 3.
- 4. Insert the grease nipple (10) to the axle hub with the help of spanner of 9mm refer fig.1.
- 5. Take a king pin stub axle (2,3) and put it on the special fixture.
- Remove the split pin (B) & then remove castle (A) nut on the stub axle side 6. with the help of Pneumatic gun & socket no. 36.
- Insert felt ring (11) on the stub axle. 7.
- Insert the wear ring (12) on the king pin stub axle. 8.
- Insert the oil seal (20) on the king pin stub axle. 9.
- 10. Insert the Tapper roller bearing (21) onto the stub axle with the help of mandrel refer fig. 2.
- 11. Insert the axle hub on king pin stub axle.
- 12. Fit another tapper roller bearing (19) on it.
- 13. Insert the locking washer (17) on the axle.
- 14. Now insert castle nut (A) again & tight it.
- 15. Torque the castle nut with torque of 16Nm with the help of open end spanner (32mm).
- 16. Insert split pin (B) in castle nut & bend if for locking refer fig. 3.

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FIG. 2





- 24 16 5 4



- 17. Fill the grease in the grease nipple hole & mount grease nipple on axle hub.
- 18. Mount the front hub cap (15) on it along with gasket (14) with the help of three screws (16) and washers (24) refer fig. 4.with open end spanner (13mm).



- 19. Now insert the O-ring holder (4) into the king pin stub axle assembly.
- 20. Insert the O-ring (5) onto the O-ring holder.

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- 21. Insert the Thrust bearing (6) on the king pin stub axle assembly.
- 22. Insert the felt ring (7) on the king pin stub axle assembly refer fig. 5.



FIG. 5

## **F 6.0 INSPECTION PROCEDURE**

1. Check Toe-in valve - Toe in valve should be b\w 2.50 5mm.

## **TOE-IN**

When a pair of wheels is set so that their leading edges are pointed slightly towards each other, the wheel pair is said to have toe-in. The amount of toe can be expressed in degree as the angle to which the wheels are out or parallel, or more commonly, as the difference between the track widths as measured at the leasing and trailing edges of the tyres or wheels. Toe settings affect three major areas of performance : tyre wear, straight stability and corner entry handling characteristics.



#### Toe-in procedures.

Park the tractor on a leveled ground with front wheels in straight-aheadposition. Mark the center point on the width of each tyre and measure the distance between both the front tyres at the front and rear sides. For desired results, the rods or drag link ends are slackened and the rods are rotated clockwise or anticlockwise to increase or decrease the toe-in.

Toe-in =(y-x)=2.5 to 5 y= Rear side distance x = Front side distance.

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#### 2. CHECK TRACK WIDTH AS PER REQUIREMENT

Depending on the requirement of the track width the axle can be extended on both sides (except the model having non adjustable front axle).

Track width can be changed by moving the inner portion of beam in outward direction.

Bolts are shifted in next holes.

Whenever the track width is adjusted wheel toe-in must also be checked and corrected.





## 3. CHECK KING PIN INCLINATION

Inclination of the King pin from vertical is called the king pin inclination or kingpin rake. Kinpin inclination helps the straight-ahead recovery, thus providing directional stability.

When the vehicle takes a turn, the inclination of king pin causes the vehicle body to move up, in relation to the wheels. So as soon as the steering wheel is left after the turn is completed, the weight of the vehicle tends to return the wheels to the straight-ahead position.

Kingpin inclination in Sonalika tractor is 9.5° for DI-60 and 11° for other models.



#### 4. CHECK CAMBER

Camber is the tilt of the front tyre from the vertical. Camber is positive if the tilt is outward at the top and vice-versa. Camber is also called wheel rake.

It is always desirable that tyres should roll on the ground vertically so that the wear is uniform. If while running, the tyres are inclined from the vertical either inward or outwared, they will wear more on one side than the other. It is seen that because of positive camber the rolling radius at different points of the tyre tread is different as a result of which the tyre tends to roll like a truncated cone about center of rotation.

Thus the tendency of the wheel would be to toe out. The tyre will wear more on the outer side. In the same manner, a negative camber will cause the front wheels to toe-in and wear more on the inside. Initial positive camber is provided to the wheels so that when the vehicle is loaded, they automatically come to a vertical position. Sonalika Tractor camber is 2° for all models.



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#### 5. CASTOR

Castor is the angle to which the steering pivot axis is tilted forward or rearward from vertical, as viewed from the side. If the pivot axis is tilted backward (that is, the top pivot is positioned further rearward than the bottom pivot), then the castor is positive, if it's forward, then the caster is negative.

Castor is needed to create straight-line stability for one could say "Directional steering stability"

In Sonalika Tractor castor angle is nil.



#### 6. INSPECTION & REPAIR

As recommended in the Operator's Manual. The wheel hub and king pin should be periodically serviced and packed with grease. Worn-out kingpin bushes and taper roller bearings of the wheel spindle can cause wobbling of the wheels. To check the play of the king pin, the front axle should be first jacked enough so that the wheel does not touch the ground. The hold the king pin from the lower end and move it. Any appreciable play needs replacement of bushes. Similarly hold the wheel from the upper and lower sides and till it to and fro. Any play in the wheel should be adjusted. In case the play is beyond the limit wheel hub should be removed for servicing. Any sign of scouring, excessive wear or mechanical damages of the wheel spindle, bearing cone, cup or roller needs replacement. Similarly worn-out kingpin bushes should be replaced.

Bearing are given a through examination, in order to detect any crank, chippings and other process of wear. Bearings worn excessively or damaged are to be replaced with new one.

Seals are damaged replace them with new one.

Stub axle is one of the most important elements of the tractor with view of the riding safety. In case, any crack (even on surface is noticed, or it's bending replace stub axle with a new stub axle.

Inspection of the pivot pin.

Wheel hubs are inspected carefully for any cracks, particularly in the vicinity of holes accommodating the bolts. The cracked hubs are to be replaced.

Damaged grease nipples are to be replaced with new one.

The angles of front axle alignment i.e. King Pin inclination and caster angle should be accurate.

## GENERAL INFORMATION CONTENTS

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I 1.0	Manual Use	I-1
l 2.0	Information property	I-1
3.0	Agreements and definitions	I-2
I 4.0	Measurements	I-3
I 5.0	Symbology used to describe maintenance (service and repair) procedures	I-4
I 6.0	General description	I-6

#### I.1 Manual Use

#### **End users**

- Installer
- Qualified technician
- Maintenance operator

## Maintenance and repair

CONSULT THIS MANUAL THOROUGHLY, as proper functioning and good efficiency of mechanical organs depends mostly on constant and correct routine maintenance ensuring product integrity and expected life duration.

In case of any damages or anomalies, quick intervention of trained and highly qualified operators authorized (with certificate) by ITL ensure the longest life of product and avoid future impairment caused by non authorized repairing.

**Warning :** ITL warranty does not cover any injury to personnel and damage to product caused by maintenance operations of not authorized personnel and/or by operations not in compliance with ITL safety regulations and prescribed procedures.

The disassembly/assembly procedures have been outlined for a total product overhauling. They have also been described in sequence through photographs with relevant explanation for specific interventions, thus obtaining a complete and safe guide for each and every phase of an operation.

Operation description presumes that the axle has already been removed from the vehicle. To remove the axle from the vehicle refer to manual provided from vehicle manufacturer.

## I.2 Information property

This manual should be considered as ITL confidential information. All rights reserved.

No part of this manual may be reproduced, in any form or by any means, without prior written permission of ITL. Only the customer, whom the manual, together with the product, has been issued to, is allowed to use this document, and only in order to use, maintain and repair the unit.

ITL declares that the subject of this manual consists with the technical and safety specifications of the machine that the manual is referred to. The manufacturer shall not be held liable for direct or indirect damages to persons, things or animals due to an improper use of this document or of the machine or to a different use of them, which does not comply with what is provided for in this manual.

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## **I 3.0 Agreements and definitions**

#### Agreements

Illustrations like pictures, drawings and components of this manual are NOT in scale, because of limited space and editing limits, therefore they are NOT reliable to obtain values about size or weight.

Illustrations are supposed to point out the correct methods to working on the machine and its components, therefore they could not display exactly the same elements.

## Definitions

Left side (Lh): it is the left side (left hand) of the unit considering the vehicle running conditions (Fig. 1).

**Right side (Rh):** it is the right side (right hand) of the unit considering the vehicle running conditions (Fig. 1).

#### Only for axle with pinion

Axle left side : It is the left side of the axle from pinion shaft point of view toward the pinion (Fig. 2).

Axle right side : It is the right side of the axle from pinion shaft point of view toward the pinion (Fig. 2).

#### **Typographic agreements**

Note: The notes, pointed out externally to the text they refer, include important information.

**Warning :** Warning indications point out the procedures, whose partial or complete non-observance can damage the machine or the connected equipment.

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Danger: Danger indications point out the procedures, whose partial or complete non-observance can injure the operator.



FIG. 1



FIG. 2

## I 4.0 Measurements

This manual indicates all measurements in International System (SI). Use the following conversion table to convert imperial Meausre.

Conversion table of units of measurement					
S	.l.	GB/USA SYSTEM			
1	mm	0.03937	in		
10	mm	0.3937	in		
25.4	mm	1	in		
6.4516	cm <sup>2</sup>	1	sq. in		
1	m²	1550	sq. in		
16.378	m²	1	cu. in		
0.473	dm²	1	U.S. pint		
1	i	61.02	cu. in		
1	i	0.2642	U.S. gal		
1.772	g	1	οz		
0.4536	kg	1	lb		
0.00070308	kg/mm	1	lb/sq. in		
1	bar	14.51	psi		
1	kg.m	7.246	lb. ft		
1(daN)=10 (N	l) = 1,02 (kg.f)	2.24	lb. f		

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## I 5.0 Symbols used to describe maintenance (service and repair) procedures

INSTRUCTIONS	SYMBOLS
WARNING/DANGER Follow carefully all the manual instructions, in order to avoid the arise of damages to things or persons; also follow all the current security regulations, in relationship/agreement with the operative working ambient. <b>Note:</b> Not following indications/security regulations can cause serious damages to the person or machines. Such damages are not covered under ITL warranty.	$\overline{\mathbb{N}}$
REMOVE/INSTALL Applicable to : seals-gaskets-filters. Using non genuine parts can harm the machine. Such damages are not covered under ITL warranty. <b>Note :</b> when this symbol is encountered, it is recommended to follow the described procedure as well as the section B.5 warnings.	$\otimes \mathcal{O}$
OIL FILLING OR OIL LEVEL/OIL DRAIN Use only the prescribed lubricant, indicated in section C; the use of products that are not in accordance with the indicated specifications are not covered under ITL warranty. <b>Note :</b> when this symbol is encountered, it is recommended to follow the described procedure as well as the section B.5 warnings.	ζ <sup>Φ</sup> ζ <sup>Φ</sup>
LUBRICATION/GREASING Use only the prescribed lubricant, indicated on section C; the use of products that are not in accordance with the indicated specifications are not covered under ITL warranty. <b>Note :</b> when this symbol is encountered, it is recommended to follow the described procedure as well as the section B.5 warnings.	27.
ADJUSTMENTS/MEASUREMENTS Applicable to : tightening torques-preloads-backlash. Follow carefully the indicated instructions to obtain the best result. <b>Note :</b> Using non genuine parts can harm the machine. Such damages are not covered under ITL warranty.	

ITL SERVICEMANUAL

DESCRIPTION	SYMBOLS
SPECIAL TOOLS It is recommended to use the special tools as indicated in the repair manual; avoid the use of not-tested methods that can not guarantee a good result.	53
ADHESIVE AND SEALING FLUIDS APPLICATION Use only the prescribed product, indicated on section C; the use of products that are not in accordance with the indicated specifications involves the ITL warranty decline. <b>Note</b> : when this symbol is encountered, it is recommended to follow the described procedure as well as the section B.5 warnings.	
MARKING Carry out the described operations in the pre-established order.	
DISASSEMBLY/ASSEMBLY OF BULKY PARTS OR SUBASSEMBLIES	
<ul> <li>WARNING : RESPECT ASSEMBLY ORIENTATION</li> <li>The assembled elements must be oriented as described in the relative procedure or as indicated in the relative figure.</li> <li>Note : Using non genuine parts can harm the machine. Such damages are not covered under ITL warranty.</li> </ul>	
CLEANING CAREFULLY Clean with care the parts involved in the described maintenance procedure. <b>Note :</b> when this symbol is encountered, it is recommended to follow the described procedure as well as the section B.5 warnings.	
APPLY PRESSURIZED FLUID Follow with great care the indicated procedure and follow all the security procedures in order to avoid damages to persons or things.	

#### 16.0 General description

The machine should be checked and/or repaired only by qualified technicians, acquainted with its peculiar features and well aware of all safety instructions.

Before performing any operation it is advisable to carry out unit cleaning accurately by removing oil/grease encrustation and accumulation.

All disassembled mechanical parts must be cleaned accurately with suitable products to avoid possible damage. Parts should be replaced if damaged, worn out, cracked, seized, etc. as they could affect proper working.

Rotating parts (bearings, gears, shafts) and that of hardware/fasteners (O-Rings, seal rings) should be examined carefully, as they are subject to intense stress, wearing and ageing.

**Note :** In case of replacement of one part of the bevel gear set this operation requires the replacement of the other part too.

We highly advise to replace sealing parts (O-Rings, seal rings, gaskets) during every repair.

Use appropriate spare parts, nuts and bolts to avoid any other problems. Moreover, use metric tools for metric nuts and bolts and Imperial tools for the others.

Carefully reading and through understanding of these instructions will avoid damage to other components.



FIG. 3



FIG. 4







#### 16.1 Special Recommendations

Before starting any disassembly and assembly operations, read carefully the following recommendations.

#### Shafts seals

Respect the following recommendations during shaft seal assembly :

- Clean shaft very carefully and ensure that the part in contact with the shaft seal is not damaged, cut or out of roundness.
- Do not damage the seals while assembling the shaft.
- Clean shaft very carefully and ensure that the part in contact with the shaft seal is not damaged, cut or out of roundness (Fig. 3).
- Assemble the seals so that the lip is fitted towards the oil side (Fig. 4).
- Lubricate seal lips (use oil) and fill 3/4 of seal cavity with grease (Fig. 5).
- Use appropriate drivers (Fig. 6)

Warning: do not use a hammer directly on the seals.

FIG. 6

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#### **O-Rings**

Lubricate adequately before inserting them at the right place and avoid o-ring rolling while inserting the shaft (Fig. 7)

FIG. 7

#### **Adjusting shims**

Respect the following recommendations during the adjustment shims assembly:

- Use appropriate adjusting shims and measure each one separately (Fig.8).
- Complete group measurement or stampings on the shims are not always reliable : check



FIG. 8



Respect the following recommendations during the bearings assembly :

- Before reassembling the bearings, clean, check and lubricate them.
- Its advisable to heat up bearings to 80-90 °C before assembling them onto their respective shafts or to cool them (dry ice) before inserting them into corresponding bore (Fig. 9).









Always use suitable extractors to remove the bearings (Fig. 10.)

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#### **Split pins**

Respect the following recommendations during the split pins assembly :

- Before assembling elastic pins, make sure that the notch is oriented towards the stressing force (Fig. 11).
- Spiral elastic pins do not need orientation.

#### Adhesive and sealant

Respect the following recommendations during the adhesive and sealant application:

- Use adhesive and sealant as advised by manufacturer specifications.
- Do not use adhesive or sealant where similar products has been applied previously; totally remove the old product before applying the new one.
- Ensure that parts to be sealed are clean, dry and completely grease free (Fig. 12) area.
- Read the predisposed section in this manual to know the required type of adhesive and sealant and relative applications areas.

#### Oil drain

Before carry out the disassembly operations, the oil must be drained out.

#### See: C.5

Warning : Disposal of used oil must be done according to laws.

#### Cleaning

Respect the following recommendations during the axle cleaning operations :

- Wash all moving parts accurately with diesel fuel or kerosene.
- Gasoline and watery alkaline solutions are forbidden.
- Do not wash with steam or hot water, as it will be very difficult to eliminate surface humidity.
- Dry all parts with a rag or air jet to avoid scratching from abrasive residuals.
- After the cleaning operations, all the surfaces should be covered with lubricant so as to protect it from future oxidation.

#### Checks

Respect the following recommendations during the axle control operations :

- Check all grooves : assure that they are not worn out or damaged.
- Replace spoiled parts with original spare parts.
- Before the reassembly, the seals on rotating shafts must be replaced.
- Examine accurately all bearings, external rings which may be still stuck in their position and pivot pins on which rolls rotate.
- Replace those which are worn out or damaged (Fig. 13).
- Gears should not be spoled and teething should not be excessively worn out. Teeth smoothing should not be deteriorated (Fig. 14).



FIG. 11



FIG. 12







FIG. 14

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#### Ends of flanges and special tools

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Be careful when hammering special tool or flange ends, in order to avoid jeopardizing functionality and integrity of either the tools or the components on which you are operating.

#### Lubricant use

In order to lubricate the Sonalika axles correctly and to reach the exact operation temperature, it is important to use the recommended lubricants, keeping their level constant as indicated in this manual.

# J

## **GENERAL SPECIFICATIONS**

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J.2	Product Identification	J-1
J.3	General Description	J-2
J.4	Technical Features	J-3
J.5	Limited slip differential disks specifications	J-4
J.6	Main Dimensions (mm)	J-5
J.7	Maintenance and Oil Change	J-6
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#### J.1 Intended use

The axle has been designed and manufactured to be mounted on agricultural machines to transmit the power from the engine to the wheels and to allow :

• increasing of tractive force of the vehicle

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• adjusting of inner wheels' speed with outer wheels' speed during steering of the vehicle.

Never mount this axle on machines different from the ones for which it has been designed and manufactured.

If the axle is used for any other purpose than the one foreseen, ITL is not responsible for any damages or accidents caused by it.

However, when used as foreseen, operational for mailties as well as regular maintenance repair specifications given by ITL are to be observed strictly.

#### J.2 Product Identification



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#### **J.3 General Description**

The axle described in this manual consists mainly of following groups :

- STEERING CYLINDER : steering cylinder parts with adjusting system components
- EPICYCLIC REDUCTION GEAR : planetary carrier with reduction/transmission parts
- WHEEL HUB : wheel support parts containing the epicyclic reduction gears
- AXLE BEAM : load-bearing shell structure of the axle
- SUPPORTS : axle's trunnion parts to install the axle on the vehicle
- DIFFERENTIAL SUPPORT : differential housing with ring bevel gear adjusting system
- DIFFERENTIAL : differential parts with ring bevel gear
- PINION : pinion with adjusting and support parts



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#### J. 4. Technical Features

Assale anteriore - Front axle	MACHINE
CA 386243	CODE
G20.16	MODEL
Limited Slip	DIFFERENTIAL TYPE

VALUES	DESCRIPTION
250 kg	Dry weight
55°	Maximum steering angle
min. 53°	Adjustment steering angle
max. 55°	
A .2	Toe-in
2.13/1	Bevel gear ratio
6.00/1	Epicyclic reduction gear ratio
12.80/1	Total ratio
	Input rotation
0	CLOCK WISE (C.W.)
	COUNTER CLOCK WISE (C.C.W.)

ASSEMBLY MAIN DATA				
0.15 ÷ 0.20 mm	Bevel gear set backlash			
E _ 107.5 · 161.4 N	Pinion bearings preloading <sup>(1)</sup>			
$\Gamma_{\rm P} = 107.5 \div 101.4 \rm N$	(measured on $\phi$ = 29.75 mm without seal)			
$E = (E + 50.4) \div (E + 75.6)$ N	Total preloading <sup>(1)</sup> of pinion-ring gear bearings			
$\Gamma_{T} = (\Gamma_{p} + 30.4) + (\Gamma_{p} + 73.0)$	(measured on = $\phi$ = 29.75 mm without seal)			
$M_{P} = 1.6 \div 2.4 \text{ Nm}$	Pinion bearings rolling torque <sup>(1)</sup> measured without seal			
$M = (M \pm 0.75) \pm (M \pm 1.2)$ Nm	Total pinion-ring gear bearing rolling torque <sup>(1)</sup>			
$[W_T = (W_P + 0.75) + (W_P + 1.2)]$	measured without seal			
	(1) Only for new bearings			

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#### J.5 Limited slip differential disks specifications

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#### J.6 Main Dimensions (mm)



#### J.7 Maintenance and Oil Change

#### J.7.1 Main Data

DESCRIPTION	VALUES	
Oil Specification		
USE RECOMMENDED OIL ENRICHED IN ADDITIVES.	API GL4	
Note : do not use synthetic or vegetable oil without consent of		
the axle manufacturer		
Differential oil capacity	4.4 (±10%) Liters	
Epicyclic red. gear oil capacity (each side)	1.0 (±15%) Liters	



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DESCRIPTION	VALUES
Differential oil filling and level plug	1
Differential oil drain plug	2
Oil breather	3
Fill, level and drain plug of epicyclic reduction gear oil	4
Greasing point	5

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#### J.7.2 Axle Oil Change

**Warning :** To drain and fill the oil and to check the oil level the axle must be horizontal.

**Danger :** During risk of violent oil ejection, follow carefully all the safety procedures indicated in this manual and in the vehicle manual.

See: cap. B - SAFETY INSTRUCTIONS

Clean the breather (3) and the surrounding area.

To drain the oil remove the level plug (1) and the drain plug (2). Drain all oil. Clean the plug (2) and tighten it to the prescribed torque. **See :** C.7



FIG. 1



FIG. 2

Unscrew the oil fill plug (1) and fill to the bottom of the level plug hole with the specified oil.

Wait to allow the oil to flow through the axle. Check oil level and fill to the specified level if necessary.

Screw the plug (1) to the prescribed torque.

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See: C.7.



FIG. 3

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#### J.7.3 Epicyclic Reduction Gear Oil Change

**Warning :** To drain and fill the oil and to check the oil level the axle must be horizontal.

Before draining the oil from wheel end rotate the wheel end so that the plug (4) is at the highest position (Pos. A) and partially unscrew to release possible pressure.

Rotate the wheel end so that the plug (4) is toward the ground (Pos. B). Remove the plug and drain the oil.

Rotate the wheel end so that hole (4) is in the position as shown in figure.

Fill to the bottom of the fill plug hole with specified oil.

See: C.5.1

Tighten the plug to the prescribed torque.

See: C.7.



FIG. 1



FIG. 2

#### J.7.4 Service Schedule

Specified maintenance intervals are for standard-duty use.

Severe operating conditions may require more short intervals.

Operation	First Time	Ordinary Maintenance	
Axle oil change	150-200 hours	Seasonally or every 1500 hours <sup>(1)</sup>	
Clean magnetic oil plugs	first oil change	Every oil change	
Check and adjust oil level	50-100 hours	Monthly or every 300-400 hours <sup>(1)</sup>	
Clean oil breather	150-200 hours <sup>(3)</sup>	Monthly or every 300-400 hours <sup>(1)</sup>	
Greasing (if required)	150-200 <sup>(2)</sup> hours	Weekly or every 150-200 hours <sup>(1) (2)</sup>	
Lubrication works (if required)	150-200 hours <sup>(3)</sup>	Seasonally or every 1500 hours <sup>(1)</sup>	

■ this operation must be performed only by personnel authorized by the manufacturer

• this operation must be performed only by trained personnel

<sup>(1)</sup> which of both conditions comes first

<sup>(2)</sup> 50 hours for severe operating condition

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<sup>(3)</sup> at the season end if you have not reached the indicated work-hours

#### Lubricants Application Range



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#### J.8 Grease in Assembly

$\circledast$	Technolube <sup>®</sup> POLYMER 400	Apply on the indicated surfaces
	AGIP <sup>®</sup> GR MU EP2	Fill/Apply in excess



### J.9 Adhesives and Tightening Torques

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Adhesives/Sealant Application			
<	Apply on the flat contact surfaces		
	Apply on bolts thread or on pins and bushes curved surfaces		
	Note : apply only on indicated side		

Gasket Sealant					
Carraro Ref.	Presence	Adhesive make and type	<b>Technical Characteristics</b>	Strength	
A 1		Loctite <sup>®</sup> 510	Flat surface sealing	High	
A1		Superbond <sup>®</sup> 529			
4.0	0	Loctite <sup>®</sup> 573	Flat surface sealing	Low	
AZ		Superbond <sup>®</sup> 519			
A3	0	Loctite <sup>®</sup> 518	Linovon Surface Sealing	High	
		Superbond <sup>®</sup> 539	Oneven Sunace Sealing	nign	
A4	Loctite®5205		Even surface sealing with	High	
		Loctite 5205	possibility of micro movements	l ingri	

Thread Parts Sealant				
Carraro Ref.	Presence	Adhesive make and type	<b>Technical Characteristics</b>	Strength
B1	0	Loctite <sup>®</sup> 542	Locking of threaded parts	Madium
		Superbond <sup>®</sup> 321		Medium
B2	•	Loctite <sup>®</sup> 270	Locking of threaded parts	High
		Superbond <sup>®</sup> 331		i ingri
B3	0	Loctite <sup>®</sup> 986/AVX	Locking of threaded parts	High,
		Superbond <sup>®</sup> 438		Special appl.

Fixing Parts Sealant				
Carraro Ref.	Presence	Adhesive make and type	Technical Characteristics	Strength
01	0	Loctite <sup>®</sup> 405	Fixing adhesive	Medium bond
		Superbond <sup>®</sup> istant25		
C2		Loctite <sup>®</sup> 638	Fixing adhesive	Strong bond
		Superbond <sup>®</sup> 433		
C3	0	Loctite <sup>®</sup> 542	Fixing adhesive	Madium band
		Superbond <sup>®</sup> 321		iviedium bond
C4	0	Loctite <sup>®</sup> 496	Bubber fixing adhesive	Strong bond
		Superbond <sup>®</sup> SB14		

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#### J.9.1 Adhesives and Tightening Torques



#### J.9.2 Adhesives and Tightening Torques



# K

## **DISASSEMBLY AND ASSEMBLY**

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#### **D.1 Steering Cylinder Group**



#### D.1.1 Disassembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Loosen the nut (1) with enough turns till it is protruding over the threaded pin end of the tie rod (3).

Beat on the nut (1) with an appropriate hammer in order to disjoin the tie rod (3) from the swivel housing (2).

Warning: don't beat on the threaded pin end of the tie rod (3).

Note: this is a destructive operation for the nut (1).

Repeat the whole sequence at the other side.



FIG. 1

K-1

Remove the tie rods (3) and (12) by loosing the nuts (4) and (12) with a suitable wrench.

Unscrew the fastening screws (6) and take the steering cylinder (7) out of its housing, if necessary use a rubber hammer.

Remove only parts that need to be overhauled and/or replaced.



Remove the rod (17) from the cylinder case (19).

Remove the cylinder head (20) from the cylinder case (19).

Remove all the seals and O-Rings (13, 14, 16, 18, 21 and 22) from the cylinder case (19), the cylinder heads (15, 20) and the rod (17).





FIG. 3

#### D.1.2 Assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Assemble new seals and O-Rings (13, 14, 16, 18, 21 and 22) on the cylinder heads (15, 20), on the rod piston (17) and on the cylinder body (19).



FIG. 1

K-2

Assemble the cylinder head (2) to the cylinder body (19).

Fit the cylinder head (15) on the rod (17).

Slide the pre-assembled rod (17) into the cylinder body (19).



FIG. 2

Fit the tie rods (3) and (12), the ball joints (5) and (10), the nuts (4) and (11) to the ends of the rod (17), then tighten with a dynamometric wrench to the requested torque.

See: C.7



FIG. 3

Install the steering cylinder (7) already assembled on the central body.

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Assemble and tighten the screws (6) with dynamometric wrench to the requested torque.

See: C.7



FIG. 4

K-3

Align the swivel housing (8) with the axle.

Screw the tie rod (12) so that its ball joint can be inserted into the swivel housing (8) arm.

**Note :** It is important to unscrew the lock nut (11) to carry out this operation. Repeat the whole sequence of the mentioned operations to the other side.



FIG. 5

Insert the ball joint of the tie rod (3) into its housing on the swivel housing (2).

Assemble and tighten the lock nut (1) with a dynamometric wrench to the requested torque.

See: C.7

Repeat the whole sequence of the mentioned operations to the other side.



FIG.6

Screw the lock nuts (4) and (11) of the tie rods (3) and (12) only when the toe-in adjustment has been carried out.

See : D.9



FIG. 7

#### D.2 Epicyclic Reduction Gear Group



#### D.2.1 Disassembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Drain the oil completely from the planetary carrier.

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See: C.5.3





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Unscrew and remove both fastening screws (1) of the planetary carrier (3) with a wrench.





Remove the planetary carrier (3) from the wheel hub and collect the relative O-Ring (4).

Position the planetary carrier (3) on a workbench and check its wear conditions.



FIG. 3

If required replace the planetary gears as follows :

- remove the lock rings (9) on every pin;
- remove the triangular plate (8);
- remove the planetary gears (7) from the pins;
- collect the needle bearings (6), checking their conditions;
- collect the washer (5).





#### D.2.2 Assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Collect all epicyclic reduction gear parts : the planetary carrier (3), the thrust washers (5), the needle bearings (6), the planetary gears (7), the triangular plate (8) and the snap rings (9) of every pin.

Note : with new planetary gears is advisable to assembly new roller bearings.





Position the planetary carrier on a workbench.

Insert the thrust washers (5) and the epicyclic gears (7) in the planetary carrier pins.

Insert the needle bearings (6) in the epicyclic gears (7).

Note : grease well the needles (see C.6).

Assemble the triangular plate (8) and the related snap rings (9).





Assemble a new O-ring (4) on the planetary carrier (3). Assemble the epicyclic reduction gear on the wheel hub.



FIG. 3

Assemble the screws (1) and tighten them to the prescribed torque. **See :** C.7



FIG. 4

Top up the oil on the wheel hub.

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See: C.5.3

Fit the filling/drain and level oil plug (2) on the planetary carrier (3) and tighten to the prescribed torque.

Vedi: C.7



FIG. 5

#### **D.3 Wheel Hub Group**



#### **D.3.1 Disassembly**

Some of the following pictures may not show exactly your axle, but the indicated operations are correct anyway.

Remove the steering cylinder group and the epicyclic reduction gear group.

#### See : D.1 and D.2

Insert a lever between the swivel housing (14) and the axle beam and fit it into the double U-Joint.

With the lever push the double U-Joint in the direction of the wheel hub to allow the lock ring (1) removal.

Warning: do not damage the double U-Joint.



FIG. 1

Remove the lock ring (1) from the double U-Joint shaft. Collect the double U-Joint shaft washers (2) and (3).

Unscrew and remove the fastening bolts (5) from the wheel carrier (7).



FIG. 2



FIG. 3



FIG. 4



FIG. 5

Remove the steel lock ring (8) and disjoin the wheel carrier (7) from the epicyclic ring gear (4)

Only if necessary, remove the centering bushes (6) from the wheel carrier with a hammer and the special tool CA715086.

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To extract the wheel carrier screw two of the just removed bolts (5) in the threaded holes.

Remove the wheel carrier (7) with the epicyclic ring gear (4).

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Remove the wheel hub (11) using levers and a hammer to facilitate the operation.

Note: collect the bearing cone (9).



FIG. 6

Position the wheel hub (11) on a flat surface and remove the seal ring (13) with an extractor.

Note: destructive operation for the seal ring (13).

Remove the bearing cups (9) and (12) using a hammer and a suitable drift.

Remove the bearing cone (12) from the swivel housing end (14), using a suitable extractor.



FIG.7



Danger : before removing the king pins (16) and (18), secure the swivel housing (14) with a belt or a rope to a hoist or any other supporting device; observe all current safety regulations to guarantee operator's safety.

Remove the king pins (16) and (18)





Remove the swivel housing (14) from the axle beam and from the short shaft of the double U-Joint.

Collect the belleville washers (25) and (27).

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FIG.9

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K-11

Position the swivel housing (14) on a flat surface and take the seal ring (23) out with an extractor.

Note: this is a destructive operation for the seal ring.

Overturn the swivel housing and take the bush (22) out, using a suitable drift and a hammer.



Remove the two double U-Joints (24) from the axle beam (26).

L

т





FIG. 11

#### **D.3.2 Assembly**

the screw (21) and nut (20).

and a hammer or a press.

done. See: D.9

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

If it has been previously removed, reassemble the steering stop composed by

Note : do not tighten the nut (2) until the steering angle adjustment has been

Force the bush (22) into the swivel housing (14) with the special tool CA119097

Assemble the seal ring (23) on the swivel housing (14) with the special grease.

Insert the double U-Joint (24) inside the axle beam (26).

Warning: be careful not to damage the seal ring inside the axle beam.



FIG. 1

FIG. 2



FIG. 3

If the cone (15) of the spherical joint has been previously removed, reassemble it to the lower king pin (16) using the special tool CA715451 under a press.

Grease carefully the seats of king pin (16) and (18) with specific grease.

т

#### See: C.6

Position the belleville washers (25) and (28) on the king pin (16) and (18) housings.



FIG. 4

SERVICE MANUAL

K-13

**Danger :** secure the swivel housing (14) with a belt or a rope to a hoist or any other supporting device.

Protect the splined end of the axle shaft by winding it with an adhesive tape to avoid damage to the seal ring (23).

Assemble the swivel housing (14) on the axle beam and after assembly, remove <u>completely</u> the adhesive tape.







#### See: C.7

**Note :** make sure that the belleville washers (25) and (27) remain in their position.



FIG. 6





The special operation "Set Right" of the bearings (9) and (12) does not require preload or backlash adjustment. Anyway, before assembling new components check the indicated dimensions.

Force both bearing cups (9) and (12) to their wheel hub (11) housings using the special tool CA715026 under a press or with a hammer.

Insert the seal ring (13) into the wheel hub (11) with the special tool CA715509 and a hammer.

Note: do not lubricate the seal ring (13)



FIG.8

Assemble the bearing cone (12) on the swivel housing (14) end. Assemble the wheel hub (11) on the swivel housing (14) and fit the bearing cone (9).



FIG. 9

Position the wheel carrier (7) on a workbench and force the bushes (6) to the carrier surface level with the special tool CA715086.

At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



FIG. 10



FIG. 11

FIG. 12

SERVICE MANUAL

K-15

Preassemble the wheel carrier (7) and the epicyclic ring gear (4) with the lock ring (8) shown in figure.

Assemble the wheel carrier group on the wheel hub using the two projecting bushes as dowel pins and screw the relative screws (5) in order to put in contact the ring bevel gear with the wheel hub.

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Force all the hub dowel bushes (6) completely with the special tool CA715086 and a hammer.

Assemble the wheel carrier (7) fastening bolts (5) and tighten to the requested torque.

See: C.7



FIG. 13

Insert a lever between the swivel housing (14) and the axle beam and fit it into the double U-Joint.

With the lever push the double U-Joint in the direction of the wheel hub to make easier the lock ring (1) insertion.



FIG. 14



т

 $\ensuremath{\text{Note}}$  : check that the lock ring (1) is correctly fitted in its seat. Push the double U-Joint thoroughly.



FIG. 15

#### **D.4 Trunnions Group**



#### **D.4.1 Disassembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Remove the front support (11) from the axle housing (8).

Remove the V-ring (10) from the axle.

Note : destructive operation for the V-ring.

Remove the bush (9).

Note : destructive operation for the bush.

Т

T.

L



FIG. 1

K-17

Remove the rear support (1).

Remove the V-ring (2) and the bush (3) from the differential support (7). **Note :** destructive operation for the V-ring.



FIG. 2



FIG. 3



FIG. 4

Remove the seal rings (4) and (6) from the sleeve (8). **Note :** destructive operation for the seal rings.

Т

T.

L
### D.4.2 Assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Insert the bush (9) into the axle beam (8) with the special tool CA715643 and a hammer.



FIG. 1

Insert the V-ring (10) in the axle beam (8) with the special tool CA715656 and a hammer.

Warning: the seal lip must be positioned on the external side.

See : next point.

Lubricate the seal ring (10) (see C.6).

Assemble the front support (11) to the axle beam (8).

L

T.



FIG. 2



Insert the bush (3) into the differential support with the special tool CA715643 and a hammer.

Warning: the seal lip of the V-ring (10) must be positioned on the external side.



FIG. 4

K-19

Assemble the seal ring (4) to the sleeve (5) with the special tool CA715644 and a hammer.

Assemble the O-ring (6) to the sleeve (5).

 $Lubricate \,the\,O\text{-ring}\,(6)\,with\,the\,prescribed\,grease.$ 

See: C.6



FIG. 5

Apply sealant on the sleeve (5). **Note :** apply sealant on indicated surface only. **See :** C.7



Assemble the sleeve (5) to differential support. Warning : align bushing slots and lube oil holes. See : next point.





FIG. 8

K-20

SERVICE MANUAL

Warning: bushing slot must be positioned on lube oil holes.

L

T.

Insert the V-ring (2) in the differential support with the special tool CA715656 and a hammer.

Warning: the seal lip must be positioned on the external side.

See : next point.

Lubricate the V-ring (2).

Assemble the rear support (1) to differential support.

П



FIG. 9

Warning: the seal lip of the V-ring (2) must be positioned on the external side.



FIG. 10

# **D.5 Differential Support Group**



### **D.5.1 Disassembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Drain the oil completely from the differential.

## See: C.5.2

Disassemble the wheel/double U-Joint group from the axle beam as described in K.10.1.

Remove the seal ring (11) from the axle beam 912).

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**Warning :** remove the double U-joint from the differential before disassembling the differential support group.



FIG. 1

Screw out the screw (2) and the screws (3) and remove the differential support (1)

**Warning :** Support the differential support (1) with a rope or other appropriate means.

Measure the **starting total preloading**  $F_{\tau_0}$  of the bearings (pinion-crown gear system), using a dynamometer whose cord is wound on the pinion splined end.

Note the value  $F_{\scriptscriptstyle TO}$  that is necessary in the bearings reassembly.



FIG. 2

The second

FIG. 3



FIG. 4



FIG. 5

Unscrew the adjuster ring nuts (4) and (10) using the special tool CA715651. **Note :** destructive operation for the ring nuts (4) and (10).

Remove the differential housing (7).

See: D.5.2 step (10)

The bearing cones (I6, 8) are removed together with the differential housing. **Warning :** do not invert the bearing cone if the bearings are not replaced.



#### **D.5.2 Assembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Assemble the bearings cone (6, 8) on the differential housing (7).

Warning: do not invert the bearing cones if the bearings are not replaced.

Assemble the bushes (5) and (9) to the new nut gears (4) and (10) with the special tool CA715652 and a hammer.

Position the complete differential box with bearings on the differential carrier

Assemble and tighten both adjuster ring nuts (4) and (10) in the differential support with special tool CA715651, till the backlash is eliminated and the

Move the differential group so to place the bevel crown gear on the pinion.

Warning : Check the right side of the bevel crown assembly.

Insert the adjuster ring nuts (4) and (10).

Note : Use new ring nuts only.

Note: Use new bushes only

(1).



FIG. 1



FIG. 2

FIG. 3



differential bearings are slightly preloaded.Note : Check that the differential bearings are well settled; if necessary, knockslightly with a soft hammer, in order to properly set the bearings in position.

K-24

FIG. 4

Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the crown gear with a 90° angle.



FIG. 5

Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.

Repeat this operation on two or more teeth and calculate the average of measured backlash values.

Check if the average backlash value is within the requested range :

## 0.15 to 0.20 mm

If this condition is verified go to the step (10), if not carry out the backlash adjustment as follows.

Adjust the ring nuts (8) and (12) by using the special tool CA715651.

**Warning :** unscrew/screw the adjuster ring nuts, as indicated in the next step, both of **about 30 degrees at once** then check the backlash.









Adjust the ring nuts (4) and (10), remembering that :

T.

(A) - if the measured backlash is greater than the given tolerance range, unscrew the adjuster ring nut (10) and screw in the adjuster ring nut (4) by the same measure;

(B) - if the measured backlash is less than the given tolerance range, unscrew the adjuster ring nut (4) and screw in the adjuster ring nut (10) by the same measure.





SERVICE MANUAL

K-25

Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.



FIG. 9

FIG. 10





F<sub>Tm</sub>

FIG. 12

The total preloading  $F_{\tau m}$  is measured on the special tool CA715657 (gaguge diameter  $D_m$ = 9.1 mm).

The measured value should be within the following range :

$$F_{Tm}$$
 = ( $F_{Pm}$  + 16.4) to ( $P_m$  + 24.6) N

where  $\mathbf{F}_{Pm}$  is the effectively preloading measured on the special tool CA715657 (gague diameter  $D_m = 91.5$  mm).

Warning : values for new bearings.

See : D.7.1 to measure  $F_{Pm}$ 



SERVICE MANUAL

Once the pinion-ring gear backlash has been established, if the bearings have not been replaced, measure the total preloading  $F_{\tau_m}$  of the bearings (pinion-crown bevel gear system), using a dynamometer whose cord is wound on the pinion splined end.

**Warning :** do not use this method with new bearings, if the bearings have been replaced see next step.

The measured value  $\mathbf{F}_{\tau_m}$  should be within the following range (see D.5.1 step [3]):

 $F_{Tm} = F_{T0} \text{ to } (F_{T0} + 10) \text{ N}$ 

follow the operating procedures in step (17).

If the bearings have been replaced, measure the total preloading  $F_{Tm}$  of the bearings (pinion-crown bevel gear system), using a dynamometer whose cords is wound on the special tool CA715657 inserted on the pinion splined end.

Note : if you do not use the prescribed special tool to measure the total preloading  $F_{\tau_m}$  the reference diameter is the diameter of pinion shaft splined end.

The measured value should be within the range indicated in C.4:

$$F_{Tm} = (F_{Pm} + 50.4)$$
 to  $(F_{Pm} + 75.6)$  N

Where  $F_{Pm}$  is the pinion bearings preloading (see D.7).

Warning : with new bearings this way give inaccurate result and it's not recommended.

Once the pinion-ring gear backlash has been established, instead proceeding with step (11) and (12) measure the total rolling torque  $(M_{Tm})$  of the bearings (pinion-crown bevel gear system) with a torque meter and the special wrench CA715107.

See:C.4

Warning : All preloads must be measured without the seal installed.

The total rolling torque  $M_{Tm}$  must be within the following range (see C.4):

where  $M_{Pm}$  is the pinion bearings preloading.

See : K.7.2 to measure M<sub>Pm</sub>

 $M_{Tm} = (M_{Pm} + 0.75)$  to  $(M_{Pm} + 1.12)$  Nm



FIG. 13



FIG. 14



FIG. 15

If the measurement is not within the requested range, check well the assembly of each component and operate on the adjuster ring nuts (4) and (10) of the differential support :

(A) - if the total preloading is less than the given range, screw in both adjuster ring nuts (4) and (10) by the same measure, keeping the pinion-ring gear backlash value unchanged;

(B) - if the total preloading is greater than the given range, unscrew both adjuster ring nuts (4) and (10) by the same measure, keeping the pinion-ring gear backlash value unchanged.





SERVICE MANUAL

K-27

Once all the adjustment operations have been completed, chalk the adjuster ring nuts (4) and (10).

Warning: chalk with care the adjuster ring nuts (4) and (10).



FIG. 17



FIG. 18



FIG. 19



SERVICE MANUAL

K-28

Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.

Spread a film of adhesive on the contact surface between the axle beam (11) and the differential carrier (1) (see C.7).

Note : check that two dowel pins (12, 13) are in their housing.

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Assembly the differential carrier (1) to the axle housing (11), and tighten the fastening screw (2) and the fastening screws (3) to the requested torque.

See: C.7

Assemble the wheel/double U-Joint group before filling the differential support with oil.

See: D.10.2

Fill the axle with the prescribed oil.

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See: C.5.2



FIG. 1

### D.5.3 Bevel gear marking test

### NOTA

To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.

The marking test should be always carried out on the ring bevel gear teeth and on both sides.





ок 2

FIG. 2



FIG. 3

### **OK** -> Correct contact :

If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

**Z**->Excessive contact on the tooth tip:

Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.

X -> Excessive contact at the tooth base :

Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.

Movements to correct :

1 -> move the pinion for type X contact adjustment

2-> move the pinion for type Z contact adjustment.

т

# **D.6 Differential group**



### D 6.1 Disassembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

K-31

Remove the differential group from the differential support group.

See: D.5

Remove the bearing cups (2) from differential housing (5).

Warning: do not invert the bearing cups if the bearings are not replaced.



FIG. 4

Remove the screws (6) and remove the bevel gear crown (1). **Warning :** this operation make free the spider (11).

Extract washers (4), counter disks (7), disks (8, 9) and sun gear (10).



FIG. 1



FIG. 2



FIG. 3

Extract pin (14). Extract the spider (11). Collect all the components. Check the operating and wear conditions of the components.

Т

т

Remove the snap rings (3).

K-32

#### **D.6.2 Assembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

**Note :** assemble the pinion group before proceeding with differential group assembly.

Position the differential box (5) on a workbench and assemble: spider (11), planetary gears (12), thrust washers (13), pin (14) as shown in figure.



FIG. 1

Assemble the crown gear (1) to the differential box (5).

Apply the prescribed sealant on fastening bolts (6).

See: C.7

Assemble the bolts (6) tighten them to the requested torque. **See :** C.7



FIG. 2

Position the differential box (5) on a workbench and assemble these inner components: sun gear (10), locking differential disks (8) and (9), locking differential counterplate (7) and washer (4), as shown in figure.

**Note :** the first disk (9) must be assembled with friction material on the disks side and the flat surface on the sun gear (10) side.

See: C.4

Assemble the snap ring (3).



FIG. 3

Assemble the inner components on the other side of the box (5): sun gear (10), disks (8) and (9), counterplate (7) and washer (4), as shown in figure.

**Note :** the first disk (9) must be assembled with friction material on the disks side and the flat surface on the sun gear (10) side.

See: C.4.

Assemble the snap ring (3).



FIG. 4

Assemble the bearing cups (2) to the differential housing (5) with the special tool CA715299 and a hammer.

Warning: do not invert the bearing cups if the bearings are not replaced.

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T.



FIG. 5

# **D.7 Pinion Group**



## **D.7.1 Disassembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

K-35

Remove the differential group. **See :** D.5

Measure the **starting preloading**  $F_{P0}$  of the pinion bearings using a dynamometer whose cord is wound on the pinion splined end.

**Warning :** note the value  $F_{_{P0}}$  that is necessary in the bearings reassembly.

See: D.7.2 step (15)

L

Т





Lock the differential carrier with a vise.

Unscrew the lock nut (10) using special tools CA715080 and CA715107. **Note :** this operation will irretrievably damage the lock nut (10).

Remove the ring nut (10) and collect its retaining washer (9).

Tap the shaft with a soft hammer to remove the bevel pinion (1).

Warning: take care not to drop the bevel pinion (1).

н

Т

(8).



FIG. 2



FIG. 3



FIG. 4

FIG. 5

Remove the bearing cups (3) and (8) from the differential carrier (7) using a drift and a hammer.

Collect the washers (4) and (6), the collapsible spacer (5) and the bearing cone

K-36

To remove the cone of the tapered roller bearing (3) of the bevel pinion (1), use a standard extractor.

Collect the bearing cone (3) and the underlying shim (2).



FIG. 6

Check all pinion components for wear.

L

Т

Warning : the ring nut (10) and the collapsible spacer (5) must be replaced when reassembling the unit.



FIG. 7

#### D.7.2 Assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Place the differential support (7) on a workbench. Fit the bearing cups (3) and (8) using the special drift CA119068 and a hammer.



FIG. 1

Insert bearing cones (3) and (8) in their housings. Assemble the false pinion CA715653 (a1) and its ring nut (10). Tighten without exceeding the ring nut, till the backlash is eliminated.

Install special tool CA715654 (a2) to the differential group supports 7).



FIG. 2



FIG. 3



FIG. 4

Use a depth gauge to measure distance "X" (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base or the bearing).

T.

K-38

To adjust bevel gear/pinion measure the distance "A" with a depth gauge. Calculate the value "X" as follows :

$$X = (A + C) - B mm$$

where "B" and "C" are known.

distance), from the measured value (X).



FIG. 5



FIG. 6



FIG. 7



FIG. 8

SHIMS RANGE										
Thickness - mm	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
Quantity										

Select the shim (2) thickness value (S) among the range of available shims.

Remove the special tool CA715654 to the differential group supports (7). Remove the ring nut (10), the false pinion CA715653 (a1) and the bearing cones (3) and (8).

1

Т

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K-39

SERVICE MANUAL

S = X - V mm

In order to determine the necessary thickness value (S) between the pinion and the bearing, subtract the value (V), stamped on the pinion head (V=requested

Once you have chosen the suitable shim (2), insert it on the pinion shaft with the chamfer against the pinion head, as shown in figure.

Force the bearing (3) into the pinion shaft (1) with the special tool CA715082 under a press, making sure that it is well set.

Insert the shims (4) and (6) and a new collapsible spacer 95).

Note : use always a <u>new</u> collapsible spacer (5).

Note: check the right assembly sequence.

н

Т



FIG. 9





Insert the bevel pinion (1) unit into the differential support housing (7) and the bearing cone (8) on the pinion shaft, as shown in figure. Use the special tool CA715082 and a hammer to drive the bearing (8).





SERVICE MANUAL

K-40

Insert the ring nut washer (9) and screw a new lock ring nut (10) on the pinion end.

FIG. 13

Screw the ring nut (10), in, using the wrench for ring nut CA715080 and for pinion retainer CA715107.

**Warning :** the torque setting is given by the preloading measurement on bearings (3) and (8); tighten the ring nut (10) gradually.

**Note :** if the tightening is excessive, the elastic spacer (5) must be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion ends (1) with a soft hammer, so as to help setting the bearings (3) and (8).

$$F_{Pm} = F_{P0}$$
 to ( $F_{P0}$  + 10) N

If the bearings have been not replaced, to measure the preloading  $F_{Pm}$  of the pinion taper roller bearings (3) and (8), use a dynamometer whose cord is wound on the end of pinion shaft (1).

**Warning :** do nut use this method with new bearings, if the bearings have been replaced see next step.

The measured value should be within the following range (see D.7.1 step [1]) :

$$F_{Pm} = F_{P0}$$
 to ( $F_{P0} + 10$ ) N

follow the operating procedures in step [21].

If the pinion taper roller bearings (3) and (8) are new, to measure the preloading  $F_{Pm}$  of the bearings, use a dynamometer whose cord is wound on the special tool CA715657 inserted on the end of pinion shaft.







FIG. 15





SERVICE MANUAL

K-41

The effectively preloading  $F_{Pm}$  is measured on the special tool CA715657 (gauge diameter  $D_m = 91.5$ mm)

The measured value should be within the following range :

$$F_{Pm} = 35 \text{ to } 52 \text{ N}$$

Warning: values for new bearings.



FIG. 17



FIG. 18



FIG. 19



FIG. 20

SERVICE MANUAL

K-42

**Note :** if you do <u>not</u> use the prescribed special tool to measure the pinion bearing preloading, the reference diameter is the diameter of pinion shaft splined end.

The measured value should be within the range indicated in C.4:

$$F_{Pm} = 107.5$$
 to 161.4 N

Instead proceeding with step [16] and [17] measure the pinion shaft bearings rolling torque  $M_{Pm}$  with a torque meter and the special wrench CA715107.

Warning: all the preloads must be measured without the seal ring.

The measured value  $M_{\mbox{\tiny Pm}}$  must be within the following range :

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See: C.4

The adjustment is carried out by increasing the ring out (10) torque gradually.

Warning: All preloading must be measured without the seal rings.

Once the requested preloading value is achieved, fix the ring nut (10), using a hammer and a chisel.



FIG. 21

L

T.

L

# D. 8 Axle Beam Group



## **D.8.1 Disassembly**

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Remove the seal rings (5) from the axle beam (1).

Note : Destructive operation for the seal rings.

Remove the bush (4) from the axle beam (1) only if the wear conditions require it.

Warning: Be careful not to damage the bush seat.

L.

Т





K-44

Remove the upper king pin bush (2) and the ball bearing cup (3) from the king pin seats using a suitable extractor only if the wear conditions require this.





### D.8.2 Assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Cool the upper king pin bush (2) and the ball bearing cup (3) at a temperature lower than - 100 °C with liquid nitrogen.

Warning : wear safety gloves.

Assemble the ball bearing cup (3) on the lower king pin seat with the special tool CA715451 and a hammer.



Assemble the bush (4) on the axle beam (1) with the special tool CA715649 and a hammer.

Assemble the seal ring (5) on the axle beam with the special tool CA716288 and a hammer.

Note: grease carefully the seal rings (see C.6).





SERVICE MANUAL

K-45

Warning: assemble the seal ring (5) as in figure.

I.

T.

L

If the wheel/double U-joint group is assembled couple it to the axle as described in D.10.2.







FIG. 4

# D.9 Toe-in/Steering Angle



## D.9.1 Toe-in Adjustment

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Put two equal one-meter-long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

**Warning :** The two bars should be fixed in the middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis; align the two bars.

L

T.





K-47

Measure the distance in mm between the bars ends with a tapeline.



FIG. 2

Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.

See : "Toe-in" in C.4.

The nominal toe-in-value (A) is referred to the external diameter of the wheel hubs flange, therefore the measured value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter.

nominal toe-in (C.4) = A  $_{.2}^{0} \longrightarrow$  measured toe-in = M  $_{.5}^{0}$ 

L

T.

If toe-in is incorrect, operate with two wrenches on the guide rods (1) screwing in and out the two joint tie rods (3) equally till the toe-in is within the requested tolerance.









SERVICE MANUAL

K-48

After adjusting, screw in the lock nuts (2) of the guide rods (1) to the requested tightening torque.

See: C.7



FIG. 5



FIG. 1



FIG. 2



FIG. 3

SERVICE MANUAL

### D.9.2 Steering angle adjustment

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.

For the steering angle adjustment, set a protractor to the following calculated angle C :

### $C = 90^{\circ} - S$

Where S is the prescribed adjustment steering angle.

#### See: C.4

Position the protractor on the long bar.

Move a wheel side till it forms, with the two bars, the calculated angle C.

Adjust the mechanical steering stop, screwing in or out the stop bolts (4), locking them with the nuts (5) to the requested tightening torque.

### See: C.7

Steer completely towards the other side and repeat the same operations.

T.

K-49

# **D.10 Special Repair Operations**



## D.10.1 Wheel and double U-joint group Disassembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

K-50

Drain the differential oil completely from the axle.

## See: C.5.2

Remove the nut (2) and detach the tie rod (3) from the swivel housing (1) as described in "Steering cylinder group, Disassembly".

Warning: don't beat on the threaded pin end of the tie rod (3).

т

**Note :** this is a destructive operation for the nut (2); use a new nut in the reassembly.





**Warning :** do not unscrew the tie rod (3) nor the nut (4) to preserve the correct toe-in adjustment.



FIG. 2

**Danger :** secure the swivel housing (2) with a belt or a rope to a hoist or any other suitable supporting device.

Unscrew and remove the fastening screws (5) and (9) from the upper (6) and lower (10) king pin.



FIG. 3



FIG. 4



FIG. 5

Remove the wheel hub/reduction gear group from the axle.

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T.

Remove the king pins (6) and (10).

Note : collect the belleville washers (7) and (8).

K-51

### D10.2 Wheel and double U-joint group assembly

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Assemble the wheel/double U-joint group to the axle bam.

Note : the differential support group must be assembled to the axle (see relative section in this document).

Warning : be careful not to damage the seal ring (11); couple with care the double U-joint splined end to the differential.

Grease carefully the seats of king pin (6) and (10) with specific grease.

Position the belleville washers (7) and (8) on the king pin seats.

retaining screws (9) and (5) to the requested torque.

See: C.6

See: C.7







FIG. 2

Insert the ball joint of the tie rod (3) into its housing on the swivel housing (1).

Warning: do not unscrew the tie rod (3) nor the nut (4) to preserve the correct toe-in adjustment.



FIG. 3

Assemble and tighten the lock nut (2) with a dynamometric wench to the requested torque.

See: C.7



FIG. 4

Check the differential oil level from the oil fill plug (14) and fill up if necessary.

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L

T.

See: C.5.2

Reassemble the plug (14) to the prescribed torque.

See: C.7



FIG. 5

## D.10.3 Double U-joint Seal Ring Replacement on Axle Beam Side

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Disassemble the wheel/double U-joint group from the axle beam as described in K.10.1

Remove the seal ring (11) from the axle beam (12).

Warning: be careful not to damage the seal ring seat.



Assemble the seal ring (11) on the axle beam (12) with the special tool CA711688 and a hammer.

Note: grease carefully the seal ring (see C.6).





Warning: assemble the seal ring (11) as in figure.

Check the correct position of the seal ring after the assembly.

T.

Assemble the wheel/double U-joint group to the axle beam as described in K.10.2




#### D.10.4 Double U-joint Bushing Replacement on Axle Beam Side

Some of the following pictures may not show your product axle, but the indicated operations are correct anyways.

Disassemble the wheel/double U-joint group from the axle beam as described in K10.1.

Remove the seal rings (11) from the axle beam (12).

**Note :** destructive operation for the seal ring (11); the seal ring must be replaced in the assembly.

Use a puller to remove the bush (13) from the axle beam (12).

Warning: be careful not to damage the bush seat.



Assemble the new bush (13) on the axle beam 912) with the special tool CA715649 and a hammer.



Assemble the seal ring (11) to the axle beam 912) as described in D.10.3.

Note: grease carefully the seal rings (see C.6.)

Check the correct position of the seal ring after the assembly.

T.

Assemble the wheel/double U-joint group to the axle beam as described in K.10.2.



FIG. 3

#### **D.11 Testing After Assembly**

#### **D.11.1 Testing Methods**

#### Step 1

With engine off, lift the axle so that the tyres get away from the ground.

#### Step 2

Engage the gear so that the pinion gets locked.

#### Step 3

With the help of another person standing on the opposite side, begin the assembly testing by rotating as much as possible both the wheels forward. (Both the wheels should get locked after a while).

#### Step 4

keeping the pinion locked, free the right wheel and rotate the left one in the line of march. Rotate the right wheels in the opposite direction.

The wheel will move freely without difficulty and the right wheel will move in the opposite direction if the assembly has been carried out correctly.

Repeat the same operation in the opposite direction (reverse gear).

T.

IF ONE WHEEL DOES NOT ROTATE FREELY IN BOTH DIRECTIONS, then check all assembly operations step by step. Check and see that the brakes are regulated correctly and functioning properly.



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T 3.0	Axle Problems and Diagnosls	L-4

PROBLEMS	POSSIBLE CAUSES										
	1	2	3	4	5	6	7	8	9	10	11
Wheel vibration; front tyre resistance; halfshaft		•									•
breakage.		•	•								•
Steering is difficult; vehicle goes straight while		•		•							•
turning.		•	•	· ·							•
No differential action; jamming while steering.	•	٠	•	•			•		•		•
Uneven wear of tyre.	•	٠	•	•	•	•	•				•
Friction noise.	•			•	•			•	•	•	•
Vibration during forward drive, intermittent											
noise.		•	•		•						

#### T.1 Solving Action

1.	Incorrect installation / defective axle
0	Correct installation or repair or replace the differential in case it does not survive any one of the test phases.
2.	Remove excessive weight and redistribute load, following instructions related to the vehicle.
3.	Different rotation radius of the tyres
	If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied.
	The other tyre with bigger radius will have to support all the work.
4	Replace the type of adjust pressure to have same radius on both type. Broken halfshaft
	It is not advisable to operate the vehicle with a broken halfshaft. It is acceptable to move the vehicle (engine off unloaded)
	a few meters away.
5.	Bent halfshaft
6	Replace nalisnan.
0.	Abnormal functioning of the differential.
	Verify assembly and all components.
	Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp
	turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.
7.	Incorrect wheel adjustment
	Adjusting according.
8.	Spoiled or worn out axle parts
	Check the condition of ring gear, pinion gear, bearings, seals etc. Replace when ever necessary.
9.	Contamination in the axle box or incorrect assembly of parts
	Check assembly of the various parts of the axle
10.	Incorrect adjustment of bevel gear set : Parts of the transmission worn out.
	(transmission gears, U joints, etc.)
	Replace or adjust as required.
11.	Incorrect use of the product See the vehicle producer instructions once again
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#### T.2 TROUBLESHOOTING

This chapter is a descriptive and explanatory guide to common axle problems. This guide suggests the repair correct procedures to be followed.

PROBLEM	CAUSE	ACTION
Ring gear tooth broken on the outer side	<ol> <li>Excessive gear load compared to the one foreseen</li> <li>Incorrect ear adjustment (excessive backlash)</li> <li>Pinion nut loosened</li> </ol>	<ul> <li>Replace bevel gear set</li> <li>Follow carefully the recommended operations for the adjustment of bevel gear set backlash</li> </ul>
Ring gear tooth broken on the inner side	<ol> <li>Load bump</li> <li>Incorrect gear adjustment (insufficient backlash)</li> <li>Pinion nut loosened</li> </ol>	<ul> <li>Replace bevel gear set</li> <li>Follow carefully the recommended operations for the adjustment of bevel gear set backlash.</li> </ul>
Pinion or ring gear teeth worn	<ol> <li>Insufficient lubrication</li> <li>Contaminated oil</li> <li>Incorrect lubrication or depleted additives</li> <li>Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.</li> </ol>	<ul> <li>Replace bevel gear set.</li> <li>Follow carefully the recommended operations for the adjustment of bevel gear set backlash.</li> <li>Use correct lubricants, fill up to the right levels and replace according to the recommended program.</li> </ul>
Overheated ring and pinion teeth. See if gear teeth have faded	<ol> <li>Prolonged functioning at high temperatures</li> <li>Incorrect lubrication</li> <li>Low oil level</li> <li>Contaminated oil</li> </ol>	<ul> <li>Replace bevel gear set.</li> <li>Use proper lubrication, fill up to right level and replace at recommended program.</li> </ul>
Pinion teeth pitting	<ol> <li>Excessive use</li> <li>Insufficient lubrication</li> </ol>	<ul> <li>Replace bevel gear set.</li> <li>use correct lubrication, fill up to the right level and substitute at recommended intervals</li> </ul>
Axle beam body bent	<ol> <li>Vehicle over loaded</li> <li>Vehicle's accident</li> <li>Load bump</li> </ol>	— Replace axle beam body
Worn out or pitted bearings	<ol> <li>Insufficient lubrication</li> <li>Contaminated oil</li> <li>Excessive use</li> <li>Normal wear out</li> <li>Pinion nut loosened</li> </ol>	<ul> <li>Replace bearings.</li> <li>Use correct lubrication fill up, to the right level and replace at recommended intervals</li> </ul>

PROBLEM	CAUSE	ACTION
Oil leakage from gaskets and seals	<ol> <li>Prolonged functioning at high temperature of the oil</li> <li>Oil gasket assembled incorrectly</li> <li>Seal lip damaged</li> <li>Contaminated oil</li> </ol>	<ul> <li>Replace the gasket or seal and matching surface if damaged.</li> <li>Use correct lubrication and replace at recommended intervals.</li> </ul>
Excessive wearing out of input flange spline	<ol> <li>Exhaustive use</li> <li>Pinion nut loosened</li> <li>Pinion axle backlash</li> </ol>	<ul> <li>Replace the flange.</li> <li>Check that the pinion spline is not excessively worn out.</li> <li>Replace bevel gear set if required.</li> </ul>
Failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	<ol> <li>Exhaustive use</li> <li>Continuous overload</li> </ol>	— Replace bevel gear set
Pinion and ring teeth breakage	1. Crash load of differential components	<ul> <li>Check and/or replace other differential components.</li> </ul>
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	Excessive use	<ul> <li>Replace differential gear group.</li> <li>Replace halfshaft if required.</li> </ul>
Thrust washer surface worn out or scratched.	<ol> <li>Insufficient lubrication</li> <li>Incorrect lubrication</li> <li>Contaminated oil</li> </ol>	<ul> <li>Use correct lubrication and fill up to right level.</li> <li>Replace at intervals recommended</li> <li>Replace all scratched washers and those with 0,1mm thickness lower than the new ones.</li> </ul>
Inner diameter of tapered needle bearing worm out.	<ol> <li>Excessive use</li> <li>Excessive pinion axial backlash</li> <li>Insufficient lubrication</li> <li>Contaminated oil</li> </ol>	<ul> <li>Replace bearing.</li> <li>Check pinion axial backlash.</li> <li>Use proper lubrication, fill up to right level and replace at recommended intervals.</li> </ul>
Bent or broken halfshaft	Vehicle intensively operated or overloaded	— Replace halfshaft
Halfshaft broken at wheel side	<ol> <li>Wheel support loosened</li> <li>Beam body bent</li> </ol>	<ul> <li>Replace halfshaft</li> <li>Check that wheel support is not worn out or improperly adjusted.</li> </ul>

#### T.3 AXLE PROBLEMS AND DIAGNOSLS

PROBLEM	CAUSE	ACTION		
Noise while driving	1. Excessive backlash between pinion and ring gear	1. Adjust		
	2. worn out pinion and gear ring	2. Replace		
	3. Worn out pinion bearings	3. Replace		
	4. Pinion bearings loosened	4. Adjust		
	5. Excessive axial pinion backlash	5. Adjust		
	6. Worn out differential bearings	6. Replace		
	7. Differential bearings loosened	7. Adjust		
	8. Ring gear out of roundness	8. Replace		
	9. Low lubricant level	9. Oil level		
	10. Poor or wrong lubricant	10. Replace		
	11. Bent halfshaft	11. Replace		
Noise while driving in neutral	<ol> <li>Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud.</li> <li>Incorrect backlash between pinion</li> </ol>	<ol> <li>Replace or adjust (see above)</li> <li>Replace</li> </ol>		
	and ring (sound heard while decelerating disappears while increasing the speed) 3. Pinion or input flange worn out	3. Adjust		
Intermittent noise	<ol> <li>Ring gear damaged</li> <li>Differential housing bolts loosened</li> </ol>	<ol> <li>Replace bevel gear set</li> <li>Tighten to torque</li> </ol>		
Constant noise	<ol> <li>Ring gear teeth or pinion damaged</li> <li>Worn out bearings</li> <li>Pinion spline worn out</li> <li>Bent halfshaft</li> </ol>	<ol> <li>Replace bevel gear set</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ol>		
Noise while steering	<ol> <li>Worn out differential gears</li> <li>Worn out differential or spider</li> <li>Differential thrust washers worn out</li> <li>Half shaft spline worn out</li> </ol>	<ol> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ol>		

# **M** SERVICE OPERATIONS TIME

## CONTENTS

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#### S.1 Service Operations Time Schedule

Time indicated below is in accordance with medium value time of operations made by trained personnel in laboratory provided

with all necessary tools for the good execution of the requested operations.

Repair and/or substitution times are indicated in minutes.

It is presumed that the axle has already been removed from the vehicle. To know the removal time of the axle from the vehicle

refer to manual provided from vehicle manufacturer.

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Steering Cylinder Group (M3)						
a a	Cod.	Operation	Min.			
Dome in the	C1	Steering cylinder replacement	60			
	C2	Steering rod replacement (x 1)	30			
100 CT	C3	Steering rod ball joint replacement (x 1)	15			
00 mg	C4	Steering rod tie rod replacement (x 1)	30			
7	C5	Ball joint protection replacement (x 1)	15			
	C6	Tie rod protection replacement (x 1)	15			
and a second sec	C8	Steering cylinder overhauling	120			

Epicyclic Reduction Gear Group (M1)						
	Cod.	Operation	Min.			
	A1	Planetary carrier replacement	20			
	A2	Planetary carrier overhauling (3 gears)	35			
		Planetary carrier overhauling (4 gears)	45			
and the second s						

Wheel Hub Group (M1)						
	-	Cod.	Operation	Min.		
	\$ 0 P	A3	Wheel carrier replacement	30		
		A5	Wheel hub bearing and seal replacement	75		
0000		A6	Stud replacement (x 1)	5		
	\$	A7	Swivel housing overhauling	90		
	•	A8	Swivel housing replacement	70		
000		A9	Double U-joint replacement	30		
		A10	Double U-joint overhauling	60		
		A11	King ping replacement (x 1)	30		
		A12	King ping bearing replacement (x 1)	45		
		A14	Crown gear replacement (x 1)	30		

Trunnions Group (M2-M4)							
	Cod.	Operation	Min.				
	D11	Trunnion overhauling	60				
Contraction of the second	D12	Trunnion replacement	30				
	B2	Pinion/input flange seal replacement	30				
OB BOILE							
Contraction of the second							

Differential Support Group (M2)							
	Cod.	Operation	Min.				
2 mg	B1	Differential replacement	150				
all a start and a start	B4	Differential housing bearings replacement	180				
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I T L M-2		SERVICE MANUAL					

Differential Support Group (M2)					
	Cod.	Operation	Min.		
@oro ~	B1	Differential replacement	150		
	B5	Bevel gear, planetary gears, side gears,	240		
		spiders and ring nuts replacement			
COMPANIE -	B8	Differential housing bearings replacement			
COOMDO 8					

Pinion Group				
100	Cod.	Operation	Min.	
(Car	B3	Pinion bearings	180	
00°				
000				

Axle Beam Group (M4)					
	Cod.	Operation	Min.		
	D1	Axle beam replacement	180		
E Contraction of the second se	D2	Spherical bearing replacement (x 1)	45		
	D3	Double U-joint seal replacement	45		
	D4	Double U-joint bush replacement	60		
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#### ST.1.0 CIRCUIT DIAGRAM OF HYDROSTATIC STEERING



S. NO	PART NAME	Qty
1	POWER STEERING PUMP	1
2	SUCTION PIPE L BOW	1
3	SUCTION PIPE	1
4	CONNECTING HOUSE	2
5	SUCTION PIPE	1
6	OIL TANK	1
7	OIL TANK RETURN PIPE	1
8	STEERING COLUMN	1
9	CCC STEERING UNIT	1
10	HIGH PRESSURE PIPE	1

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S. NO	PART NAME	Qty
11	HIGH PRESSURE L BOW	1
12	O-RING FOR ADOPTER	1
13	HOUSE LH& RH	
14	PIPE FROM STEERING UNIT TO HOUSE	
15	CLAMP	
16	CYLINDER FLEXIBLE PIPE	
17	CLAMP PLATE	
18	ADOPTER	
19	BENJO BOLTS	

SERVICE MANUAL

N-1

### ST.2.0 Exploded View OSPJ100 ON



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Dust seal ring	17	Gear wheel set
2	Housing spool/sleeve	18	O-ring
3	Ball dia 8.5 mm	19	End cover
5	O-ring/roto glyd	20	Washer
7	Bearing assembly	22	Screw with pin
10	Ring	23	Screw
11	Cross pin	24	Name plate
12	Set of springs	30	Pressure relief valve
13	Cardon shaft	31	Spring for relief valve
15	O-ring	37	Check Valve
16	Distributor plate		

N-2

SERVICE MANUAL

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#### ST 3. 0 DETAIL VIEW OF HYDROSTATIC STEERING UNIT



PARTS DESCRIPTION	S. NO	PARTS DESCRIPTION
DUST SEAL RING	11.	CROSS PIN 6•14 MM
HOUSING + SPOOL + SLEEVE	12.	NEUTRAL POSITION SPRINGS
BALL 8.5 MM [0.33 IN]	13.	CARDON SHAFT
THREAD BUSHING	14.	SPACER
O-RING WITH KIN-RING OR ROTO GLYD	15.	WASHER 8.2 • 11.9 • 1.0 MM
O-RING 80.5 • 1.5 MM	16.	DISTRIBUTOR PLATE
BEARING ASSEMBLY	17.	SCREW
GEAR WHEEL	18.	SPECIAL SCREW
O-RING 75.92 • 1.78 MM [2.99 • 0.07IN]	19.	MAKE LABEL
RING FOR SPRINGS	20.	END COVER
	PARTS DESCRIPTIONDUST SEAL RINGHOUSING + SPOOL + SLEEVEBALL 8.5 MM [0.33 IN]THREAD BUSHINGO-RING WITH KIN-RING OR ROTO GLYDO-RING 80.5 • 1.5 MMBEARING ASSEMBLYGEAR WHEELO-RING 75.92 • 1.78 MM [2.99 • 0.07IN]RING FOR SPRINGS	PARTS DESCRIPTIONS. NODUST SEAL RING11.HOUSING + SPOOL + SLEEVE12.BALL 8.5 MM [0.33 IN]13.THREAD BUSHING14.O-RING WITH KIN-RING OR ROTO GLYD15.O-RING 80.5 • 1.5 MM16.BEARING ASSEMBLY17.GEAR WHEEL18.O-RING 75.92 • 1.78 MM [2.99 • 0.07IN]19.RING FOR SPRINGS20.

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N-3 SERVICE MANUAL

#### ST 4.0 DISMANTLING OF HYDROSTATIC STEERING UNIT OSPC

Dismantle steering column from steering unit and place the steering unit in the holding tool.

Screw out the screws in the end cover (6-off plus on special screw)

Remove the end cover, sideways



FIG. 1



FIG. 2

Lift the gear wheel set (with spacer if fitted) off the unit. Take out the two  $\,$  O - rings



FIG. 3



FIG. 4

SERVICE MANUAL

Remove the cardan shaft.

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N-4

#### Remove distributor plate

#### Screw out the threaded bush over the check valve

#### Remove O-ring

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#### Shake out the Check valve ball



FIG. 5



FIG. 6



FIG. 7



FIG. 8

SERVICE MANUAL

N-5

#### Carefully press the spool out of the sleeve.

Press the neutral position springs out of their slots in the spool

Remove dust seal and O-ring / King ring / Roto Glyd.

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FIG. 9



FIG. 10



FIG. 11



Remove the plastic Cap & Unscrew the setting screw using an 6mm hexagon socket spanner.

FIG. 12



FIG. 13

Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.





The Steering unit is now completely dismantled.

#### Cleaning

Clean all parts carefully in Shellsol K or the like.

Inspection and replacement

Replace all seals and washers.

Check all parts carefully and make any replacements necessary.

N-7

#### Lubrication

Before assembly, lubricate all parts with hydraulic oil.



FIG. 15

#### ASSEMBLING



FIG. 17



FIG. 18



FIG. 19



FIG. 20

Line up the spring set.

Guide the ring down over the sleeve. The ring should be able to move free of springs.

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Place the two flat neutral position springs in the slot.

Place the curved springs between the flat ones and press them into place.

N-8

#### Fit the cross pin into the spool / sleeve.



FIG. 21



FIG. 22



FIG. 23



## Assembly pattern for double bearing

- 1 Washer for axial bearing
- 2 Outer needle bearing
- 3 Outer bearing race
- 4 Spool
- 5 Sleeve
- 6 Inner needle bearing
- 7 inner bearing race

The inside chamfer on the inner bearing race must face the inner spool.

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N-9

SERVICE MANUAL

Assembly pattern for standard bearing

Fit bearing races and needle bearings as shown on the drawing bellow.

- 1 Outer bearing race
- 2 Needle bearing
- 3 Inner bearing race
- 4 Spool
- 5 Sleeve

#### ST.5.0 INSTALLATION INSTRUCTION FOR O-RING/KING-RING ROTO GLYD

Turn the steering unit the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool/sleeve.



FIG. 1



FIG. 2

FIG. 3





SERVICE MANUAL

N-10

Grease o-ring and king-ring/roto Glyd with hydraulic oil and place them on the tool.

Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.

Press and turn the o-ring/kin-ring into position in the housing.

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Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide for the inner part in the bore.



#### ST.5.1 INSTALLATION INSTRUCTIONS FOR LIP SEAL

Lubricate the lip seal with hydraulic oil and place it on assembly tool.



FIG. 1



FIG. 2



FIG. 3

Guide the assembly tool right to the bottom.

Press and turn the lip seal in the housing.

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N-11

With a light turning movement, guide the spool and sleeve into the bore. Fit the spool set holding the cross pin horizontal.





FIG. 4



FIG. 5

FIG.6



FIG. 7

SERVICE MANUAL

N-12

Turn the steering unit until the bore is vertical again. Put the check valve ball into the hose indicated by the arrow.

Place a ball in the two holes indicated by the arrows

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#### Place a new pin in the same two holes.

20°C [68°F].

housing.

In some cases a spring has to be fitted on the pin before it is placed in the housing.





FIG. 9



FIG. 10



FIG. 11

Place the distributor plate so that the channel holes match the holes in the

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L

Grease the o-ring with mineral oil approximate viscosity 500mm²/s [SUS] at

N-13

Guide the Cardon shaft down into the bore so that the slot is parallel with the connection flange.

Place the Cardon shaft as shown - so that it is held in position by the mounting fork.



FIG. 12



FIG. 13



FIG. 14



FIG. 15

SERVICE MANUAL

N-14

rim. Fit the gear wheel and rim on the Cardon shaft.

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Grease the two o-rings with mineral oil of approximate viscosity  $500 \text{mm}^2/\text{s}$  [SUS] at  $20^\circ \text{C}$  [°F] and place them in the two grooves in the gear

#### Caution

Fit the gear wheel (rotor) and Cardon shaft so that a tooth base in the rotor is positioned at the shaft slot as shown. Turn the gear rim so that the seven holes match the holes in the housing.

#### Fit the spacer, if any.

#### Place the end cover in position.

Fit the special screw with washer and place it in the hose as shown.

Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin with a torque of  $30\pm 6$  Nm [265.5 + /- 53 lbf.in].

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FIG. 16



FIG. 17



FIG. 18



FIG. 19

#### ASSEMBLY OF THE PRESSURE RELIEF VALVE

#### Fit the piston.

Fit the spring.

Screw in the setting screw with 8mm hexagon socket spanner. Make the pressure setting on a panel or the vehicle.

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FIG. 20



FIG. 21



FIG.22

#### ST.6.0 MAX. TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

- T : Tank
- L : Left port
- P : Pump
- R : Right port

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L.



	Max. Tightening Torque N-m [lbf.in]				
Screwed connection	With cutting edge	With cooper washer	With aluminium washer	With O-ring	
G1⁄4	40(350)	20(180)	30(270)	-	
G <sup>3</sup> / <sub>8</sub>	60(630)	20(180)	50(440)	-	
G½	100(900)	30(270)	80(700)	-	
<sup>7</sup> / <sub>6</sub> -20 UNF	-	20(180)	-	-	
<sup>3</sup> / <sub>4</sub> - 16 UNF	-	60(530)	-	-	
M12 + 15	40(350)	20(180)	30(270)	20(180)	
M18 + 15	70(620)	20(180)	50(440)	50(440)	
M22 + 15	100(900)	30(270)	80(700)	70(620)	

#### ST.8.0 ASSEMBLY OF THE SHOCK VALVES

Put a ball in two holes indicated by the arrows



FIG. 1



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spring applies to setting range 170-260 bar.



FIG. 2



FIG. 3

Screw in the two setting screws using a 6 mm hexagon socket spanner. Make the pressure setting on a panel or the vehicle

Screw plug with seal ring into the two shock valves and tighten them with a torque of 30 + 10 Nm using a 6 mm hexagon socket spanner. Steering unit is now assembled.

Place the dust seal in the housing. Dust seal ring must be placed only after the pressure relief valve and shock valves have been fitted.

Fit the dust seal ring in the housing with plastic hammer.

Press the plastic plugs into the connection ports. Do not use a hammer.



FIG. 4



FIG. 5



FIG. 6



FIG. 7

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#### **ST.9.0 HYDROSTATIC STEERING UNIT**

#### ST 9.1 DISASSEMBLY OF STEERING UNIT

Cleanliness is extremely important when repairing a steering control unit. Work in a clean area. Before disconnecting lines, clean the port area of unit thoroughly. Use a wire brush to remove foreign material and debris from the external joints of the unit.

#### Meter (Gerotor) End :

1. Clamp unit in vice, Gerotor end up. Clamp lightly on edges of port face sides (refer fig. 1). Use protective material on vice jaws. Housing distortion can result if jaws are over tightened.

**Note :** Here figures are not shown in vice, but it is recommended that you keep the unit in a vice during disassembly. Follow the clamping procedure.







FIG. 2



FIG. 3

2. Remove M10 cap screws. Refer fig. 2.

- 3. Remove end cap. Refer fig. 2.
- 4. Remove seal. Refer fig. 2.

- 5. Remove Gerotor set. Refer fig. 3.
- 6. Remove seal. Refer fig. 3.
- 7. Remove drive spacer. Refer fig. 3.

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- 8. Remove drive. Refer fig. 4.
- 9. Remove spacer plate. Refer fig. 4.
- 10. Remove seal from housing. Refer fig. 4.
- 11. Remove housing from vice.

position. Refer fig. 6.



FIG. 4

12. Carefully remove all cavity check valves and manual steering check valve from bolts holes by tipping. Refer fig. 5.



FIG.5



FIG.6

- 15. Remove the bearing, needle thrust bearing and bearing race, step by step from the housing. Refer fig. 7.
- 16. Remove seal from seal gland bushing. Refer fig. 7,

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14. Push pin from spool sleeve assembly. Refer fig. 6.





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17. Push spool partially from control end of sleeve, then carefully remove centering springs from spool by hand (refer fig. 8). Low input torque unit uses four centering springs and two spacers. Standard input torque unit uses six centering springs.

**NOTE :** There are different kinds of spool and sleeve set. Do not remove any valve other than manual steering check valve and anti-cavity check valves. All other valves are factory present and are non-serviceable.



FIG. 8

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#### ST 10.0 ASSEMBLY OF STEERING UNIT

Check all mating surface. If any part have scratches or burns, the steering unit must be replaced. Use of parts with scratches or burns can cause leakage and is not recommended. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe with the cloth or paper towel because lint or other matter can get into the hydraulic system and cause damage. Do not use grit paper or file or grind these parts.

#### Meter (Gerotor) End :

1. Assembly spool and sleeve carefully so that spring slots line up at the same end. Rotate spool while sliding parts together.

**Note :** Lubricate all seals with clean petroleum jelly. A good service policy is to replace all old seals with new seals. Do not use excessive lubricant on seal for Gerotor section.

Test for free rotation. Spool should rotate smoothly in sleeve with finger tip force applied at splined end. Align spool and sleeve by matching marks, if present. Refer fig. 9.

2. Centering springs for low input torque units have four arched springs with two flat spacers in the center as shown in fig. 10.

Centering springs for standard input torque units have six arched springs.

Position centering springs so that the notches line up, and arched center sections are nested together. Next with spring notches facing sleeves, insert one end of entire spring set into spring installation tool.

- 3. Compress extended end of spring set and push into tool-sleeve assembly-Keep pressure on spring ends while withdrawing installation tool and pushing forward on springs at same time.
- Center spring set in spring slots. Seat springs down evenly and flush with upper surface of spool and sleeve.
- 5. Insert pin through spool-sleeve assembly until pin is within the outside diameter of sleeve.
- 6. Lubricate seal before installation in seal gland bushing in housing. Use upper seal-instalation tool, to make sure seal enter seal gland bushing without bearing cut.

**CAUTION :**Do not use any seal that fails freely into counter bore of seal gland bushing.

7. Install two bearing race and needle thrust bearing as shown in fig. 12.







FIG. 10



FIG. 11





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8. Position spool-sleeve assembly so that splined end of spool enters end of housing first.

**CAUTION :** While inserting spool sleeve assembly into housing, make sure parts do not tilt out of position. Push assembly gently into place with slight rotation action, keeping pin from moving out and getting stuck in the internal groove.

Bring spool-sleeve assembly entirely within housing bore. With spoolsleeve assembly in this flush position, check for free rotation within housing by turning assembly with finger tip force at splined end.

9. Clamp housing in vice, clamp lightly on edges of mounting area, do not over tight jaws.

**NOTE :** Check to insure that spool and sleeve are flush or slightly below 14 hole surface of housing. Clean upper surface of housing by wiping with palm of clean hand. Clean each of the flat surface of parts in Gerotor section in similar way just before reassembly. Do not use cloth or paper to clean surface.



FIG. 13



- 10. Install 77.5 ID seal in housing.
- 11. Install anti-cavity check valves and manual steering check valve in holes, as shown in fig.
- 12. Install spacer plate. Align bolt holes in spacer plate with tapped holes in housing.



FIG. 15

- 13. Rotate spool and assembly unit pin in parallel with part face. Install drive, making sure drive is engaged with pin. To assure proper alignment mark drive as shown in fig. 16 reference B. When marking drive note relationship of slotted end of drive to splined end of drive.
- 14. Lubricate and install 77.5 ID seal in Gerotor ring. The lubrication will hold seal in place.
- Align star valleys with pin. Note parallel relationship of reference lines A, B, C, & D in fig. Align bolt holes without disengaging Gerotor star from drive.




- 16. When used, install drive spacer in Gerotor star.
- 18. Lubricate and install 77.5 ID seal in Gerotor ring.
- 19. Install end cap alignment holes.
- 20. Install 7 dry cap screws in end cap. Pre tighten screws to 17Nm, then torque screws to 35-45 Nm in sequence shown in fig. 17.
- 21. Check for proper timing by turning the spool clockwise end feeling pressure in the "R" port.



FIG. 17

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#### ST.7.0 POWER STEERING FAULT LOCATION TIPS Steering Units : OSPB - OSPC - OVP/OVR - OLS

Fault	Possible Cause	Remedy	
A) Steering wheel is heavy to turn	<ol> <li>No or insufficient oil pressure         <ul> <li>a) Pump does not run</li> <li>b) Pump defective</li> <li>c) Pump runs in the wrong direction</li> <li>d) Pump is under dimensioned</li> </ul> </li> </ol>	<ul> <li>a) Start up pump (loose V-belt)</li> <li>b) Repair or replace pump</li> <li>c) Correct direction of rotation of pump or replace pump</li> <li>d) Install a larger pump (examine pressure need and flow)</li> </ul>	
	<ol> <li>Pressure relief valve is stuck in open position or setting pressure is too low.</li> <li>Priority valve is stuck in open position.</li> <li>Too much friction in the mechanicals pans of the vehicle.</li> <li>Emergency steering balls missing.</li> <li>Combination : Downstream system + steering unit with suction valve and differential cylinder are inexpedient.</li> </ol>	<ol> <li>Repair or clean pressure relief valve. Adjust the valve to the correct pressure.</li> <li>Repair or clean the priority valve.</li> <li>Lubricate bearings and joints of steering gear or repair if necessary.</li> <li>Install new balls.</li> <li>Change cylinder type (through going piston rod). If necessary use two differential cylinders.</li> </ol>	
<ul> <li>B) Regular adjustments of the steering wheel are necessary ("Snake-like driving")</li> </ul>	<ol> <li>Leaf spring without spring force or broken.</li> <li>Spring in double shock valve broken.</li> <li>Gear wheel set worn.</li> <li>Cylinder seized or piston seals worn.</li> </ol>	<ol> <li>Replace leaf springs.</li> <li>Replace shock valve.</li> <li>Replace gear wheel set.</li> <li>Replace defective parts.</li> </ol>	
C) Neutral position of steering wheel can not be obtained, i.e. there is a tendency towards "motoring"	<ol> <li>Steering Column and steering unit out of line.</li> <li>Too little or no play between steering column and steering unit input shaft.</li> <li>Pinching between inner and outer spools.</li> </ol>	<ol> <li>Align the steering column with steering unit.</li> <li>Adjust the play and, if necessary, shorten the splines journal.</li> <li>Contact the nearest service shop.</li> </ol>	
D) "Motoring" effect. The steering wheel can turn on its own.	<ol> <li>Leaf springs are stuck or broken and have therefore reduced spring force.</li> <li>Inner and outer spools pinch, possible due to dirt.</li> <li>Return pressure in connection with the reaction between differential cylinder and steering unit too high.</li> </ol>	<ol> <li>Replace leaf springs.</li> <li>Clean steering unit or contact the nearest service shop.</li> <li>Reduce return pressure, change cylinder type or use a non-reaction control unit.</li> </ol>	
E) Backlash	<ol> <li>Cardan shaft fork worn or broken.</li> <li>Leaf springs without spring force or broken.</li> <li>Worn splines on the steering column.</li> </ol>	<ol> <li>Replace cardan shaft.</li> <li>Replace leaf springs.</li> <li>Replace steering column.</li> </ol>	
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#### POWER STEERING FAULT LOCATION TIPS Steering Units : OSPB - OSPC - OVP/OVR - OLS

	Fault	Possible Cause	Remedy	
F)	"Shimmy"-effect. The steered wheels vibrate. (Rough tread on tyres gives vibrations)	<ol> <li>Air in the steering cylinder.</li> <li>Mechanical connections or whee bearings worn.</li> </ol>	<ol> <li>Bleed cylinder. Find and remove the reason for air collection.</li> <li>Replace worn parts.</li> </ol>	
G)	Steering wheel can be turned the whole time without the steered wheels moving.	<ol> <li>Oil is needed in the tank.</li> <li>Steering cylinder worn.</li> <li>Gear wheel set worn.</li> <li>Spacer across cardon shaft forgotten.</li> </ol>	<ol> <li>Fill with clean oil and bleed the system.</li> <li>Replace or repair cylinder.</li> <li>Replace gear wheel set.</li> <li>Install spacer.</li> </ol>	
H)	Steering wheel can be turned slowly in one or both directions without the steered wheels turning.	<ol> <li>One or both anti-cavitation valves are leaky or are missing in OSPC or OVP/OVR.</li> <li>One or both shock valves are leaky or are missing in OSPC or OVP/OVR</li> </ol>	<ol> <li>Clean or replace defect or missing valves.</li> <li>Clean or replace defective or missing valves.</li> </ol>	
1	Steering is too slow and heavy when trying to turn quickly.	<ol> <li>Insufficient oil supply to steering unit, pump defective or number of revolutions too low.</li> <li>Relief valve setting too low.</li> <li>Relief valve sticking owing to dirt.</li> <li>Spool in priority valve sticking owing to dirt.</li> <li>Too weak spring in priority valve.</li> </ol>	<ol> <li>Replace pump or increase number of revolutions.</li> <li>Adjust valve to correct setting.</li> <li>Clean the valve.</li> <li>Clean the valve, check that spool moves easily without spring.</li> <li>Replace spring by a stronger (There are 3 sizes : 4, 7 and 10 bar).</li> </ol>	
J)	"Kick-back" in steering wheel from system. Kicks from wheels.	1. Fault in the system	1. Contact vehicle supplier or Danfoss.	
К)	heavy kick-back in steering wheel in both directions.	<ol> <li>Wrong setting of cardon shaft and gear wheel set.</li> </ol>	1. Correct setting as shown in Service Manual.	
L)	Turning the steering wheel activates the steered wheels opposite.	<ol> <li>Hydraulic hoses for the steering cylinders have been switched around.</li> </ol>	1. Reverse the hoses.	
M)	Hard point when starting to turn the steering wheel.	<ol> <li>Spring force in priority value too weak.</li> <li>Air in LS and / or PP pipes.</li> <li>Clogged orifice in LS or PP side priority value.</li> <li>Oil is too thick (cold).</li> </ol>	<ol> <li>Replace spring by a stronger (4, 7 and 10 bar).</li> <li>Bleed LS and PP pipes.</li> <li>Clean orifices in spool and in connecting plugs for LS and PP.</li> <li>Let motor run until oil is warm.</li> </ol>	
N)	Too little steering force (possibly to one side only).	<ol> <li>Pump pressure too low.</li> <li>Too little steering cylinder.</li> <li>Piston rod area of the differentia cylinder too large compared with piston diameter.</li> </ol>	<ol> <li>Correct pump pressure.</li> <li>Fit a larger cylinder.</li> <li>Fit cylinder with thinner piston rod or 2 differential cylinders.</li> </ol>	
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# POWER STEERING FAULT LOCATION TIPS Steering Units : OSPB - OSPC - OVP/OVR - OLS



# **ELECTRICAL SYSTEM**

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#### **E 1.0 INTRODUCTION**

The electrical system mainly covers components related to Starting system, Charging system and Accessories system.

#### E 2.0 MAJOR COMPONENTS OF ELECTRICAL SYSTEM

The major components of the electrical systems are as follows :

- E 2.1 STARTING SYSTEM
  - Battery.
  - Starting motor.
  - Wiring.
  - Harness.
  - Switches.

#### E 2.2 CHARGING SYSTEM

- Alternator.
- Regulator with wiring.

#### E 2.3 ACCESSORIES SYSTEM

- Horns.
- Lighting.
  - Instrument panel warning systems.

#### **E 2.1 STARTING SYSTEM**

#### **¤ BATTERY**

The battery supplies electrical energy to operate the starting motor when the engine is being started. It also acts as voltage stabilizer by supplying current for the lights, and other electrical accessories. The battery is an electrochemical device. This means it uses chemicals to produce electricity. The amount of electricity it can produce is limited. As the chemicals in the battery are "used up", the battery runs down, or is discharged. It can be recharged by supplying it with electric current from a battery charger, or from the vehicle alternator. The "used up" chemicals are then returned to their original condition, so the battery becomes recharged.

#### **BATTERY MAINTENANCE**

- Complete battery maintenance includes the following :
- 1) Visually check the battery. Look for signs of leakage, a cracked case or top, corrosion buildup on battery terminals and tops, missing vent caps, and loose or missing hold-down clamps.
- 2) Check electrolyte level in cells on batteries with vent caps.
- 3) It must be 1.5 cm above the plates. If necessary, top up with distilled water or if you have none use carefully filtered rainwater. Never add acid.
- 4) Clean off corrosion around battery terminals. As batteries with the terminals on top, the terminals and cable clamps sometimes corrode. Cleaning the terminal and clamps with special wire brush after disconnecting the clamps can clean off this corrosion. Brushing the top with baking-soda solution can clean off battery-top corrosion. Flush off the battery top with water after the foaming. Terminals can be coated with an anti-corrosion compound to retard corrosion.
- 5) Check battery condition by testing its state of charge. On vent-cap batteries, the battery can be checked with a hydrometer. The hydrometer tests the specific gravity of the battery electrolyte.

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- 6) Recharge battery if it is low. The value of a fully charged electrolyte is 1265. If below 1215 recharge the battery.
- 7) Protect against freezing. Also check that the terminals are clean and tight.

#### **E2.1.1 SPECIFICATIONS**

• FOR 4-CYL MODELS Type & Rating : 12V, 88 Ah Capacity & Rating : 88 Ah at 20 hr. rating

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#### **¤ METHOD OF CHARGING**

- 1) Before checking electrolyte level make sure the battery is clean.
- 2) Top the electrolyte level if necessary.
- 3) Connect the charger correctly to the battery terminals, and then switch on the charger.
- 4) You must know the battery capacity (Ah) and the technical characteristics of your charger to determine how long to charge the battery.

For example

- 1) To recharge the battery in 10 hours, set your charger to 11 amps (110/10=11)
- 2) The longer the charging time. The longer the battery will store its charge.
- 3) Once the battery is charged, always switch off the charger before disconnecting the battery.
- 4) Replace the plugs.
- 5) Reconnect the cables and lubricate the terminals to avoid formation of sulphate.

#### **¤ CAUTIONS FOR BATTERY SERVICE**

- 1) The sulphuric acid in the electrolyte is very corrosive. It can destroy most things it touches it can cause serious burns if it gets on your skin. If it gets in your eyes., it can blind you. For this reason, always wear eye protection when working around batteries. If you get battery acid on your skin/eyes, flush it off with water immediately.
- 2) Gas is formed in the battery when it is being charged. These gases are highly explosive. Never light a match or a cigarette when working around batteries. You might cause an explosion that could seriously harm you.
- 3) The battery can supply a very high current. Never wear rings, bracelets, watches, or hanging necklaces when working around batteries.
- 4) When disconnecting a battery, always disconnect the cable from the grounded terminal first.

#### **x** STARTING MOTOR

The internal-combustion engines are cranked by a small but powerful electric motor. This motor is called the cranking motor, starter, or starting motor. The battery sends current to the starting motor when the driver turns the ignition switch to start. This causes a pinion gear in the starting motor to mesh with teeth on the ring gear around the engine flywheel. The starting motor then rotates the engine crankshaft for starting.

#### **x** STARTING SYSTEMTROUBLES

1) The starting motor does not crank the engine.

The most likely cause of this condition is a run-down battery. But there could be other causes. Turn on the headlights, and try cranking. There are five possibilities.

- a. **No cranking, no lights.** This is probably due to a completely run down battery. It could be caused by a loose connection at the battery or starting motor or an open fusible link.
- b. No cranking, but lights as you turn the key to start. This usually indicates a bad connection charged battery.
- c. **No cranking, and lights dim as you try to start.** The trouble probably is in the starting motor. The pinion may not be engaging with the flywheel. If the starting-motor armature spins, then the overrunning clutch is slipping.
- d. No cranking, and lights dim heavily as you try to start. This is most likely due to a run-down battery. It could be low temperature, too. The battery is much less efficient at low temperatures, and the engine oil is much thicker. This combination could prevent cranking, even though the battery is in fairly good condition. Also the starting motor or engine could be jammed, or locked.

#### 2) The starting motor cranks slowly, but the engine does not start.

This is very likely due to a run-down or defective battery. The battery is unable to spin the starting motor at normal speed. Low temperature could also be a factor. It is also possible that the driver may have run the battery down trying to start. Some condition in the engine, or the fuel system, is preventing normal starting.

#### **¤** HARNESS

Each harness has a connection sheet, which corresponds to numbered tags that we attach to each wire. We use original type materials including covered wire and rubber terminal insulators. Plastic covered wire is insulated with cross-linked polyethylene, which has a resistance to environmental stress, cracking, cut-through, ozone, solvents, and heat.original type materials including covered wire and rubber terminal insulators.

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**FUSE BOX** : Fuse box is mounted on the dashboard. Remove the cover of fuse box by unscrewing the screw of cover. All fuse details are mentioned on fuse box cover. Replace the fuse whichever not working.

### 2.2 CHARGING SYSTEM

The charging system has two jobs :

1) To restore the current used while starting the engine.

2) To handle the load of the lights and other electrical equipments while the engine is running.

The charging system includes the alternator, regulator and battery, with connecting wires. Alternator converts mechanical energy from the engine into electrical energy. It keeps the battery in a charged condition and handles electrical loads while the engine is running. The alternator produces alternating current (AC) inside its starter windings. Diodes convert this AC into direct current (DC).

## **x** CHARGING SYSTEM - TROUBLE DIAGNOSIS AND SERVICE

There are few troubles that might be caused by the charging system :

- Run-down battery.
- Overcharged battery.
- Alternator Noise.
- DISCHARGED / RUN DOWN BATTERY

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A discharged battery does not have enough capacity to crank the engine at normal speeds. The trouble could be due to following reasons.

**O-3** 

# Instruments and controls



Fig.3-9 Dashboard.

#### Dashboard

- 1 Mobile Charging Socket (1) (Fig. 3-10a)
- 2 Combination Switch (2) (Fig. 3-10b)

#### Integrated switch for following operations:

Only operates with ignition switch in the contact Position 2 (Fig. 3-10 b)

A: Left hand direction indicator.

B: Right hand direction indicator

C: Road light switch: turn the knob to operate the Lights and push the center button for Horn (2Fig. 3-10b)



Lights off.

Parking Light.

Dipped beams.Pushed down: driving beams.

High Beam.

Pressed horn.

- 3. Engine Stop switch. (3)(Fig. 3-10c)
- Hazard light switch.
   Lights off. 0
   Hazard lights on. 1
- 5. Rotating beacon switch (with light switch on) (Only for some models)
- 6. Ignition switch (Fig.3-10 C)

# **ENLARGED VIEWS:-**



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Fig. 3-10a - Mobile charging socket



Fig.3 10b Light, turn indicator and horn



**O-4** 

- 1. Start-and-stop driving during which the alternator could not restore the current used while starting the engine.
- 2. Accessories or lights left on when the engine is turned off.
- 3. A loose or defective alternator drive belt.
- 4. An old battery.
- 5. Defective wiring or connections such as blown fusible link.
- 6. Defective alternators, regulator, or connecting wiring.

If terms 1 and 2 above have not caused the run-down battery, and if the battery is not defective, check the drive belt for condition and tension. If the belt is okay and properly adjusted, check the wiring and connections for defects. This includes the battery-cable connections and the engine ground strap. Also, check the wiring harness for blown fusible links.

#### • OVERCHARGED BATTERY

An overcharged battery will have a relatively short life. On batteries with vent plugs, overcharging can cause electrolyte to spurt or leak from the vent plugs. This lost electrolyte reduces battery capacity. It also spreads across the battery top. There the electrolyte forms a conducting path between the battery terminals so the battery will slowly discharge. This type of slow discharge does not occur with side terminal batteries.

The escaping electrolyte is very corrosive. It can corrode the battery holder and metal surfaces close by. The condition is not noticeable with maintenance-free batteires. Overcharging means the alternator voltage is too high. Evidence of this is flaring of the headlights or internal lights. When the engine speed increases from idle, the headlight brightness increases. The excessive voltage overcharges the battery and shortens the life of the headlights, other lights, and electrical devices.

With alternators having the regulator built in, the cause of high voltage and battery overcharging is in the alternator. It must be removed for service or replacement with a new or rebuilt unit.

#### • ALTERNATOR NOISE

Noise in the alternator is probably due to worn out bearings, worn out drive belt, loose alternator mounting, damaged rotor or fan, or one or more diodes in the rectifier shorted or open. Shorts or opens in the stator could also cause nosie.

#### **¤ ALTERNATOR**

Rating:88AV

#### **¤ ADJUSTMENT**

To adjust the tension loosen the nuts (A) and (B). Tilt the alternator outwards then re-tighten the nuts (A & B). Adjustment is repeated after half an hour while running with a new belt.

#### 2.3 ACCESSORIES SYSTEM

#### **¤** HORN AND LIGHTS

In a tractor having a wheeled chassis adapted for movement over the ground; an engine supported on said chassis for providing operative power for said tractor; light supported from said chassis at selected locations, said lights being grouped into a parking light group, a headlight group and a working light group; and an operator's station supported on said chassis for supporting controls for controlling the operation of said tractor, said controls including steering means for controlling the direction of movement of said tractor, engine control means for controlling the corporation of said engine, light control means for controlling the illumination of said lights, and an instrument cluster containing displays reflecting the operation of said engine and said tractor.



DESCRIPTION	QTY	CAPACITY OF BULBS	
FRONT			
Head Lights	2	12V/45/40w	
Parking Lights	2	12V/5w	
Side Indicator lights	2	12V/21 w	
REAR			
Plough Lamp	1	12V/36w	
Tail light cum brake light	2	12V/21w/5w	
Side Indicator lights	2	12V/21 w	

# DETAILS OF LIGHTS (LAMPS) FOR ALL TRACTORS



#### E 4.0 INSPECTION PROCEDURE

Sr.No.	PROBLEM	DEFECT	IMPACT	SERVICE
1.	Normal water loss in usage reduces electrolyte volume causing increase in specific gravity of electrolyte.	Increased plate corrosion	Reduced battery life.	Topping-up with distilled water required at. recommended service intervals.
2.	Electrolyte level drops below top of plates.	<ul> <li>a) Uncovered portion of the plates become hard and inactive</li> <li>b) Extra load (both during charging and discharging) on balance portion of the plates under electrolyte.</li> </ul>	a) Battery not able to perform up to requirements. b) Reduced battery life	Topping-up with distilled water required at recommended service intervals.
3.	Reduction in electrolyte volume results in lesser cooling ability and therefore higher operating temperatures.	Increased plate corrosion.	Reduced battery life.	Topping-up with distilled water required at recommended service intervals.
4.	Drop of electrolyte level exposes top (connecting) portion of the plates	<ul> <li>a) Enhanced corrosion of connections.</li> <li>b) Disconnection of plates.</li> </ul>	<ul> <li>a) Premature failure</li> <li>of battery.</li> <li>b) Spark can occur at</li> <li>corroded portion</li> <li>resulting in battery</li> <li>explosion.</li> </ul>	Topping-up with distilled water required at recommended service intervals.
5.	Powdery layer forms on terminals/Cable-clamps due to corrosion.	The powdery layer acts as insulator and block current flow.	Vehicle will not start.	Clean the terminals and cable-clamps and apply petroleum jelly at recommended service intervals.
6.	Cable clamps can become loose.	<ul> <li>a) Improper connection</li> <li>b) Spark can be produced</li> <li>in the gap between cable- clamp and terminals.</li> </ul>	<ul> <li>a) Vehicle will not start.</li> <li>b) Battery gases can ignite resulting in explosion.</li> </ul>	Check tightness to cable-clamp during every battery service.
7.	Surface of battery become dirty.	a) Current leakage. b) Vent holes can become blocked	<ul> <li>a) Increased self- discharge.</li> <li>b) Reduced performance.</li> <li>c) Batteries can explode due to pressure build-up.</li> </ul>	Clean the surface of the battery of the cloth. Removable vent plugs can be cleaned with hot water. Side vent plugs can be cleaned with a wet cloth.
8.	Battery hold-down clamps can become loose causing battery to vibrate	<ul> <li>a) Battery can be damaged</li> <li>b) Increased shedding of plates.</li> <li>c) Connection can become loose.</li> </ul>	a) Premature failures. b) Reduced battery life. c) Vehicle will not start.	Check tightness of Battery hold-down clamp during every battery service.
9.	Defect in auto-electricals.	<ul> <li>a) Battery discharge.</li> <li>b) Increased water-loss.</li> <li>c) Battery heating-up.</li> <li>d) Increased plate corrosion.</li> </ul>	a) Inability to start b) Reduction in performance. c) Drop in battery life.	<ul> <li>a) Over-charging.</li> <li>b) Loose fan belt</li> <li>c) Current drain with</li> <li>vehicle not running</li> <li>(shorts/parasitic loads</li> <li>etc.)</li> <li>d) Starter taking load</li> <li>advise for starter</li> <li>servicing.</li> </ul>
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## E 4.1 DO AND DON'T

DO'S	DON'T'S
Ensure the correct type/capacity of battery is put in your	Do not install a lower capacity battery than
vehicle.	recommended.
Battery should be secured firmly in the cradle.	Do not top-up with acid/mineral water/tap water.
Terminal should be kept clean.	Do not hammer down clamps on the terminals.
Clamps should be firmly tightened.	
Connecting cables should be fix to correct poles.	Do not groase on terminals/cable clamps
(First +ve to +ve than -ve to -ve)	Do not grease on terminals/cable clamps.
Petroleum jelly (Vaseline) should be applied on the	Do not over fill the battery
terminals/cable clamps.	Do not over nin the battery.
	Do not keep your battery idle for more than three to four
Top of the battery should be kept clean and dry.	weeks for normal batteries and 10-12 weeks for MF
	batteries.
The electrolyte level should be up to the bottom of the	
filling hole for opaque PP container. For translucent PP	
container the level should be maintained at max line as	
indicated.	
	Current setting for charging should not be increased to
Topping up should be done with distilled water only.	quick charge the battery, as this will seriously affect
	battery life.
Keep the vent plugs clean and tight vent holes should be	The charging current should not be more than one
clear.	twentieth of rated AH capacity.
Get the output voltage regulator checked, as both over-	
charging and under-charging are harmful for the	
batteries.	
Tension on the fan belt should be adequate.	
In case of Maintenance free batteries vent plugs can be	
opened with a rupee coin.	
In case of battery lying idle ensure freshening charge is	Do not open Maintenance Free Battery vent plugs with
given once a month for normal batteries.	screwdriver/any sharp tool.
Re-charging should be done at recommended current	Do not operate or charge the battery if electrolyte
(amps) only.	temperature exceeds 60°C.

#### E 5.0 GENERAL MAINTENANCE OF ELECTRICAL SYSTEM

- Never patch up the electrical circuits.
- Never replace a blown fuse by a higher capacity fuse. It could cause fire.
- Never work on components such as the alternator or starter motor when the engine is running.
- Always disconnect the battery negative terminal on electrical circuit.
- Lastly when you are cleaning the tractor and using high-pressure spray, take care not to damage the electrical connections.

#### **BEFORE CONNECTING WELDING APPARATUS:**

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With the ignition switched off and the engine stopped, first disconnect the negative terminal on your battery (-), then the positive (+) terminal. Remove the battery and place it well away form the welding area. Sparks could cause an explosion. Disconnect the alternator.

#### PRECAUTIONS WHILE WELDING

Any form of electric welding (by sports or arc), could damage your tractors electrical fittings. Certain precautions are necessary to avoid these problems.

## **ROUTINE MAINTENANCE**

The user may carry out maintenance which requires not particular professional skills, notable routine up keeps, provided the complies with the maintenance frequencies and instructions given in this manual.

- Check battery level electrolyte every 50 hours or weekly. Top up if level is low.
- Check Fan belt tension every 50 hours or weekly. Adjust it, if loosen.

SERVICE MANUAL

O-10

# LUBRICANTS & GREASES / USES OF SPECIAL SERVICE TOOLS

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# O 1.0 RECOMMENDED GRADE OF LUBRICANTS & GREASES

TRACTOR MODEL	WORLDTRAC	WORLDTRAC
	DI-75	DI-90
DRIVE	2WD/4WD OPTION	2WD/4WD OPTION
ENGINE OIL	-	
QUANTITY (In Litres)	11.25	12
GRADE		
VENDOR		
AIR CLEANER OIL		
QUANTITY (In Litres)	DRY AIR CLEANER	
GRADE		
VENDOR	TIDE WATER OIL & HP	
BRAKES		
MAIN BRAKE	OIB	
HYDRAULIC SYSTEM		
& TRANSMISSION OIL		
QUANTITY (In Litres)	61	62
GRADE	ELF-2412	
VENDOR	ELF	
GREASE		
QUANTITY (In Ka)	0.75	0.75

# O 1.1 HYDROSTATIC STEERING OIL

Type / Grade	Dextron II D
Qty.	3.5 Liter
Vendor	Valvoline

# **O 2.0 GREASING POINTS ON TRACTOR**



Front Wheel Hubs



Rear Axle Shaft



Draft Sensing Spindle

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Centre Pin



Tie Rod (02pt.) (Left / Right)



Rocker Link Lower Hinge

P-2



King Pin



Adjustable Lift Rods



Rocker Link Upper Hinge

# O 3.0 USES OF SPECIAL SERVICE TOOLS

# SST84001 PUMP GEAR PULLER

- Insert the 'C' clamp of the tool below the gear.
- Put the 3-bolt assembly of the tool on the top of the gear and screw the 'C' clamp such that the central bolt rest over the cam shaft of the pump.
- Tighten the central bolt of the tool till the gear come out from cam shaft.

# SST84002 PISTON RING INSTALLER

- Insert the jaws of ring expander in between the piston ring end gap.
- Expand the piston ring by pressing the tool from rear end.
- Put the piston ring in groove of piston & release the expander.
- · Position the ring end gap as per recommendation

# SST84003 GAGUE FOR CONTROL VALVE SETTING

- Hold the tool in left hand firmly.
- Adjust the spool valve in the control valve assembly with the help of couplers and gauge.
- After adjustment, tight the nut of the coupler
- For position setting both lever down and arms down.
- For draft setting, positing lever down, draft lever up, arms up the sensor length is 18mm. Out from rear cover.

Note : The setting of spool valve in the control alve assembly should be 53.5 mm

# SST84004 FLY WHEEL BEARING PULLER

- · Hold the tool firmly and insert it in the flywheel bearing from expanded jaws side.
- Tight the upper bolt of the tool upto such a limit so that the four jaws will be expanded & hold the bearing firmly.
- Hold the outer body of the tool with the help of I-rod.
- On tightening the inner bolt of the tool flywheel bearing can be removed.
- Note : Avoid the over tightening of the upper bolt as it may lead to breakage

# SST84005 CRANK SHAFT REAR OIL SEAL INSTALLER

- Hold the tool from the knurled portion.
- Place the retainer on the base plate.
- Place the oil seal on the front step provided on the tool; such that oil seal lip surface faces away from the tool.
- Rest the tool with the oil seal on oil seal sitting area of the retainer.
- Gently tap it with mallet till the rear oil seal is retained inside the retainer.

# SST84006 FRONT TIMING CASE OIL SEAL INSTALLER (DI-60)

- Hold the tool from the knurled portion.
- Place the oil seal on the front step provided on the tool, such that oil seal lip surface faces away from the tool.
- Rest tool with oil seal on oil seal sitting area of the front timing case.
- Gently tap it with mallet till the timing oil seal is retained inside the front timing case cover.

















Flywheel







#### SERVICE MANUAL

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# SST84007 ENGINE SLEEVE PULLER

- Insert the sleeve puller from the top of the crank case.
- Fix the thrust plate sides at lower portion of cylinder sleeve.
- Position the bracket on top of the crank case and tighten the nut over the bracket of the puller bar, by rotating handle, the sleeve will be pulled out while tightening the nut.

# SST84007 SLEEVE PULLER

- Insert the sleeve puller from top of the crankcase inside the liner.
- Now fix the sides of thrust plate at lower portion of sleeve.
- Place the bracket on top of crankcase by rotating the handle, the sleeve will be pulled out while tightening the nut.
- We can use different types of thrust plates to pull the different diameter sleeves.

# SST84008 CLUTCH CENTRALISER GAUGE (SC)

- Hold the tool on the knurled portion.
- Insert the spigot end of the tool in the pilot bearing with the driven plate assembly.
- Mount the clutch cover assembly through the tool and bolt it with the flywheel.

# SST84009 CLUTCH CENTRALISER GAUGE (DC)

- Hold the tool on the knurled portion.
- Insert the spigot end of the tool in the pilot bearing with the driven plate assembly.
- Mount the clutch cover assembly through the tool and bolt it with the flywheel.

# SST84010 SOCKET FOR LAY SHAFT NUTS (SC)

- Lift the tools at tend side firmly in your hand.
- Fit the tool on the nut inside the gear box.
- Turn the socket with the help of L-rod in clock wise/anti clock wise direction for tightening/loosening the lay shaft nut.

# SST84011 SOCKET FOR LAY SHAFT NUTS (DC)

- Lift the tools at end side firmly in your hand.
- Fit the tool on the nut inside the gear box.
- Turn the socket with the help of L-rd in clock wise/anti clock wise direction for tightening/loosening the lay shaft nut.



























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# SST84018 STEERING WHEEL PULLER

- First of all remove the lock nut of steering wheel.
- Now insert 'C' clamp of the tool below steering wheel.
- Put the two bolt assy. of the tool on top of steering wheel & screw 'C' clamp such that it holds steering wheel firmly & center bolt of the tool rest over steering column assy.
- By tightening center bolt of the tool steering wheel can be removed.

# SST84019 THRUST PAD PULLER

- Insert the 'C' clamp of the tool in the groove of the thrust pad.
- Insert the 3-bolt assembly with long pipe in stub axle and screw the 'C' clamp such that centre bolt of the tool rests over the thrust pad.
- On tightening centre bolt of the tool thrust pad can be removed.
- Attach the small pipe with three bolt assembly & put it in the stub axle.
- Again tightening the centre bolt of the tool thrust pad can be removed from the upper portion of the stub axle.
- Thrust pad puller with small pipe can also be used for removing of steering drop arm from steering assembly.

# SST84024 RAIL FOR ALL MOBILE CARRIER (2 NOS.)

- Adjust the screw jack from its outer bearing end below the rear axle in this way, that the semi-circular bracket of the screw jack comes in forward and rearward plain of the rear axle.
- Lift the rear axle by screwing the jack.
- Lock the jack at the required position.









For removal of Thrust Pad from king Pin Stub Axle.





# SST84025 & 26 MOBILE JACK FOR DIFFERENTIAL AND GEAR BOX HOUSING

- Place the rail under the tractor properly.
- For transmission the jack is placed below the gear box rectangular part.
- For differential the jack is mounted below the differential housing.
- Jack can be lifted/lowered by varying its height.

# SST84027 MOBILE JACK FOR BELL HOUSING KET-1

- Place the rail under the tractor properly.
- For engine the jack is placed below the engine sump
- For transmission the jack is placed below clutch housing rectangular part.
- \* Jack can be lifted/lowered by varying its height.





For spliting Gear Box from Differential Housing.



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# 1035170075 MOBILE JACK FOR REAR AXLE CARRIER (2 NOS.)

- · Adjust the screw jack from its outer bearing end below the rear axle in this way, that the semi-circular bracket of the screw jack comes in forward and rearward plain of the rear axle.
- Lift the rear axle by screwing the jack.
- Lock the jack at the required position.

#### SST84039 KING PIN STUB AXLE BEARING PULLER

- Insert the 'C' clamp of the tool in the groove of the bearing.
- Insert the long pipe with 3-bolt assembly on stub axle shaft as shown & screw the centre bolt such that 'C' clamp of the tool rests over the bearing
- Tight the three bolts of the tool so that it grips the bearing properly.
- On tightening the centre bolt of the tool bearing can be removed.

# SST84041 STEERING WHEEL PULLER

- First of all remove the lock nut of steering wheel.
- Now put the 'C' clamp of the tool on steering wheel as shown.
- Tight the two bolt of the tool on top of steering wheel & screw 'C' clamp such that it holds steering wheel firmly.
- By tightening center bolt of the tool steering wheel can be removed.

# SST84043 MANDRAL FOR DRIVE SHAFT

- Insert the tool on drive shaft. •
- Press the drive shaft with mandrel.















# SST84045 C-SPANNER FOR POWER STEERING CYLINDER

- Lift the tool at end the right hand.
- Hold the 'C' ends by left hand and fix it in steering cylinder grove as shown.
- Turn the tool in anti clock wise direction for loosening and in clock wise direction for the tightening of nut.





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# 1035170048 PULLER FOR CRANK SHAFT PULLEY

- First of all are move claw nut which is at center inside the pulley.
- Then place tool from top to down to grip both corners of pulley.
- Then tighten centre bolt of the tool by placing its pulling end in center of pulley.
- We will see that pulley is coming out from the block.

# 1035170050 PULLEY FOR STEERING WHEEL

- First of all remove drive bolt from top of the timing gear.
- Insert three bolt which are in circular plate's periphery in the blind holes having thread in gear.
- Then insert centre bolt's extended edge in the slot provided on the centre of gear.
- Tighten the upper centre bolt of the tool until the gear comes out from the shaft.

# 1035170051 INJECTOR PULLER ASSY.

- Place tool on the fuel injector by keeping U shape supporting clamp towards the stud.
- Tighten the centre bolt of tool on cylinder head, so that tool hold the injector firmly.
- On tightening the nut of tool, injector will be easily removed.

# CP746H PNEUMATIC IMPACT WRENCH SIZE 1/2" SQUARE DRIVE.

- Hold the pneumatic machine firmly in the hand.
- Select proper size of socket depending on the application.
- Tighten or loosen the bolt/nut as per the requirement.
- With the help of the differential regular the operator can match the required power to the job.
- Ultimate torque of 450 ft. lbs. Can be obtained.

# 733H PNEUMATIC IMPACT WRENCH SIZE-1/2" SQUARE DRIVE.

- Hold the pneumatic machine firmly in the hand.
- Select proper size of socket depending on the application.
- Tighten or loosen the bolt/nut as per the requirement.
- With the help of the differential regular the operator can match the required power to the job.
- Ultimate torque of 450 ft. lbs. Can be obtained.

# R2/WI-PNEUMATIC IMPACT WRENCH SIZE-1/2" SQUARE DRIVE

- · Hold the pneumatic machine firmly in the hand.
- Select proper size of socket depending on the application.
- Tighten or loosen the bolt/nut as per the requirement.
- With the help of the differential regular the operator can match the required power to the job.
- Ultimate torque of 450 ft.-lbs. can be obtained.























SERVICE MANUAL

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# O 4.0 Special Tools For Transmission

The special drifts/pad used to assemble the seals, bearings and bushes should always be used interchangeably with the handle CA119033; its use is recommended together with a suitable safety handle in order to protect the hands.

# Gear box

		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac











# **O.5 Final Drive**

		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac



# O 6.0 4WD mechanical drop box

		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac



# O 7.0 PTO power take off

		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brake	75 & 90
		WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac



# O 8.0 Clutch housing - syncro shuttle

		For models
T1	12+12 MR synchro shuttle 2WD mechanical control brak	75 & 90
	e	WorldTrac
T2	12+12 MR synchro shuttle 4WD mechanical T57 drop box and mechanical control brake	75 & 90
		WorldTrac





#### O 9.0 Special Tools

The special drifts/pad used to assemble the seals, bearings and bushes should always be used with the interchangeable handle CA119033; its use is recommended together with a suitable safety handle in order to protect the hands.





# O 10.0 Hydrostatic Steering Unit

# Holding Tool

Guide ring

Assembly tool for O-ring and king-ring/Roto Glyd

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Assembly tool for lip seal



FIG. 1



FIG. 2



FIG. 3



FIG. 4

SERVICE MANUAL

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## Assembly tool for cardon Shaft

## Assembly tool for dust seal

Torque wrench 0-70 Nm. 13mm socket spanner. 6.8 and 12 mm sockets. 12 mm screwdriver. 2mm [0.08 in] screwdriver 13 mm ring spanner. 6.8 and 12 mm socket spanners. Plastic hammer.

Tweezers



FIG. 5



FIG.6



FIG. 7

SERVICE MANUAL

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